SCIENCE LIBRARY

May 14, 1927

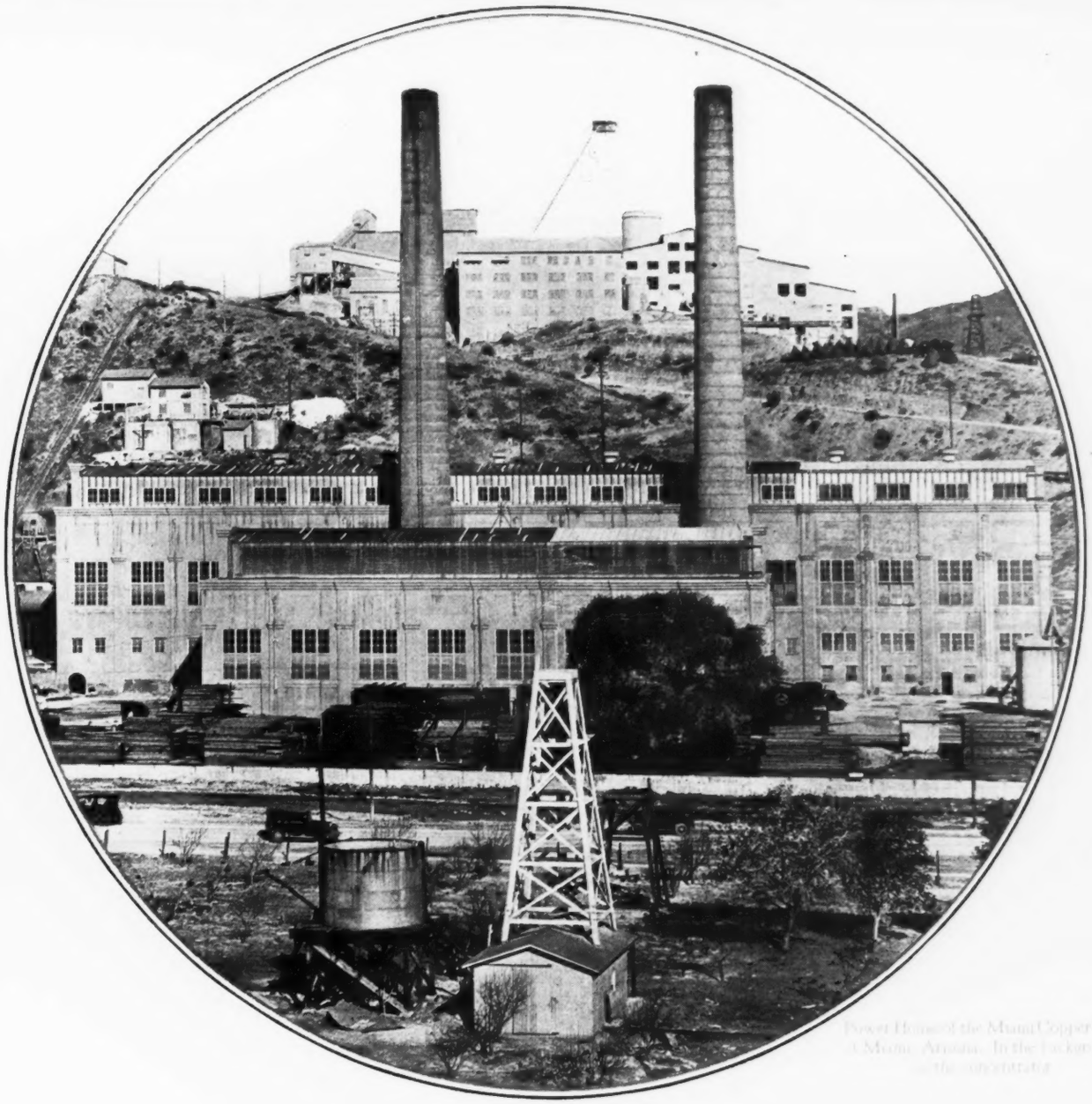
McGRAW-HILL PUBLISHING COMPANY, INC.

TWENTY-FIVE CENTS PER COPY

ENGINEERING AND MINING JOURNAL

A Consolidation of Engineering and Mining Journal and Mining and Scientific Press

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

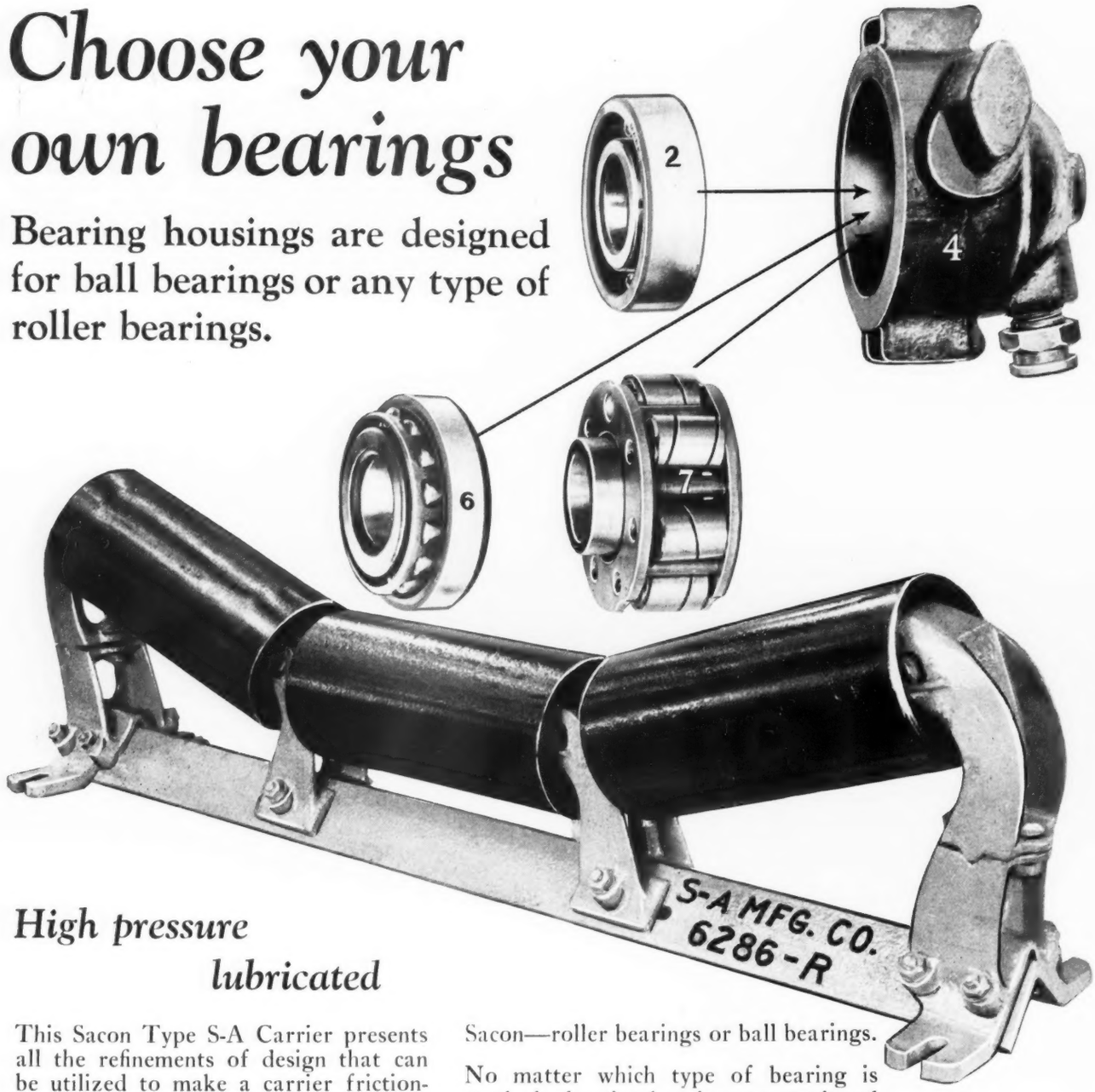


Power House of the Miami Copper Co. at Miami, Arizona. In the background is the open pit.

Africa's Iron Ore; an Unknown Quantity, by Olin R. Kuhn—Pumping 16,000 Gallons of Water Per Minute at Cerro de Pasco-I, by George B. Dillingham—Situation at the Mines—E. & M. J. Review of Statistics—Useful Operating Ideas

Choose your own bearings

Bearing housings are designed for ball bearings or any type of roller bearings.



High pressure lubricated

This Sacon Type S-A Carrier presents all the refinements of design that can be utilized to make a carrier frictionless, dust-proof, easily lubricated and sturdy enough for severe service.

Among its features are the dust-tight, self-aligning bearing housings usually equipped with ball bearings but designed for practically any type of moving bearing. The purchaser can choose the type of bearing he prefers for use in the Sacon—roller bearings or ball bearings.

No matter which type of bearing is used, the bearing housings are equipped for pressure gun lubrication and with a dust and dirt-tight grease seal. Rollers are of steel tubing with live shafts. Bearing stands are designed to facilitate bearing adjustment and to protect outer bearings from moisture and belt spillage.

STEPHENS-ADAMSON MFG. CO.
AURORA, ILL. LOS ANGELES
Branch Offices in All Principal Cities

STEPHENS-ADAMSON
S-A BELT CONVEYORS

Volume 123 May 14, 1927 *Number* 20

ENGINEERING AND MINING JOURNAL

E. H. ROBIE, *Acting Editor*

Associate Editors
GEORGE J. YOUNG, San Francisco
A. H. HUBBELL A. B. PARSONS

Contributing Editor
T. A. RICKARD, San Francisco
Assistant Editors
W. N. P. REED E. J. GEALY

Contents

Editorials 793
- Curtailment of Metal Production Important
- Diverse Views on Exploitation
- The Geneva Economic Conference Opens
- Cerro de Pasco's Pumping Problem
- Natural Tendencies and Accidents
- Iron Ore Prices Unchanged
- By the Way

***Pumping Sixteen Thousand Gallons of Water Per Minute at Cerro de Pasco—I** 796
By George B. Dillingham

Ownership and Operation of Lake Superior Iron Ores in Fewer Hands 802
By Dwight E. Woodbridge

***Africa's Iron Ore—An Unknown Quantity** 803
By Olin R. Kuhn

Useful Operating Ideas 809
- *Calculation of Longitudinal Co-ordinates
  By J. C. Pratt
- Reducing Boulders in Hard-Rock Stopes
- *Avoiding Wear on Elevator Parts
- *Releasing "Sanded" Churn Drill
  By Roy H. Poston
- *Lead Determination on Ores Containing Barium
  By B. W. Deason

Discussion 811
- The Myth of El Dorado

Mining News 812
- An Improved Clinic for the Joplin-Miami District
- The Collapse of Mount Isa Shares in London
- Another Gold Strike and Rush in the Yuma District
- Tasmania Proposes to Subsidize Prospecting
- Purchase of Humboldt Concentrator by Phelps Dodge Corporation Reported

Situation at the Mines 818
By H. D. Keiser

Societies, Addresses and Reports 819
- The International Economic Conference at Geneva
  By Edward J. Mehren

Men You Should Know About 821

Obituaries 821

Recent Technical Publications 822

Patents 823

Market and Financial News 824

Market Report 826

E. & M. J. Statistics of the Mining Industries 828

Review of Current Statistics 829
By A. B. Parsons

Metal Price Curves 830

Mining Stocks 831

New Machinery 832

Professional Directory 47-49

Searchlight Section 51-53

What and Where to Buy 54-56

Advertising Index 58

*Illustrated Article

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. McGRAW, President
JAMES H. McGRAW, Jr., Vice-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

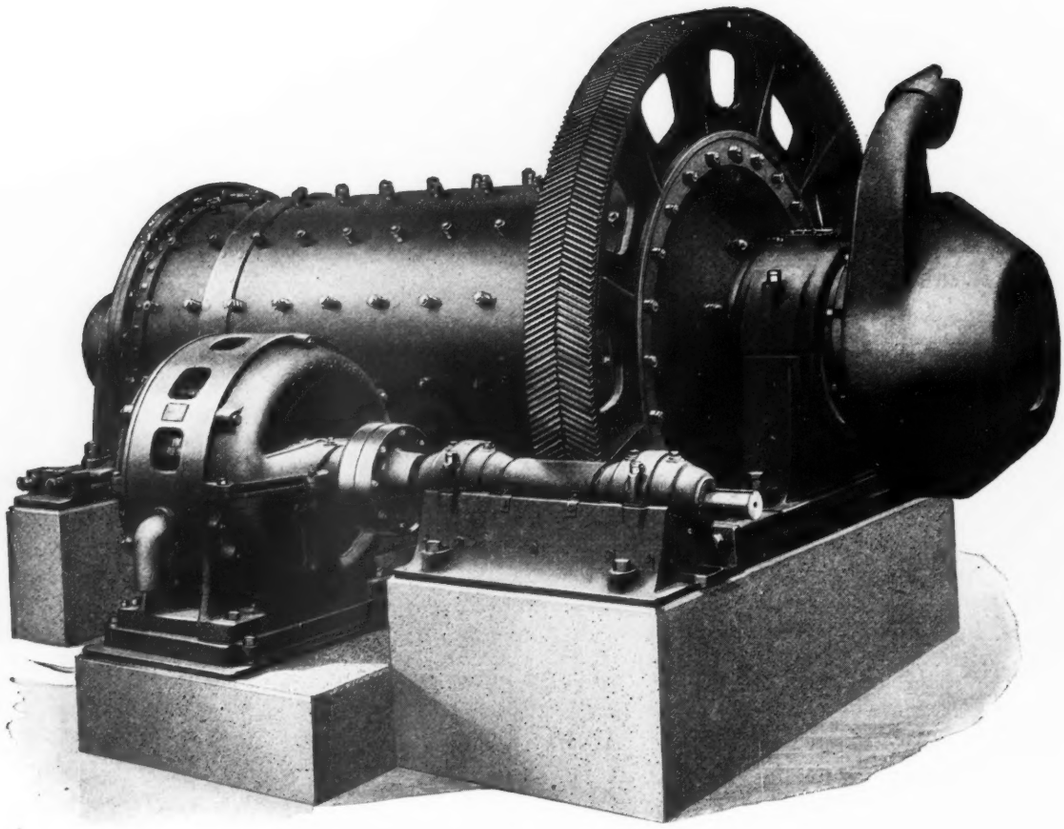
NEW YORK District Office, 285 Madison Ave.
WASHINGTON, Colorado Building
CHICAGO, 7 S. Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."
Copyright 1927
By McGraw-Hill Publishing Company, Inc.
Publishers of
Engineering News-Record American Machinist
Power Chemical and Metallurgical Engineering
Coal Age Engineering and Mining Journal
Electrical World Electrical Merchandising
Bus Transportation Electric Railway Journal
Industrial Engineer Radio Retailing
Construction Methods
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)
Ingeniería Internacional

The annual subscription rate in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Chile, Haiti and Paraguay, $5 per year. Extra foreign postage, $3 (total $8 or 34 shillings). Single copy, 25c. Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at New York at least ten days before the change takes place.
Published weekly. Entered as second-class matter June 20, 1879, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.
Member Audit Bureau of Circulations.
Member Associated Business Papers, Inc.

11,998 COPIES PRINTED THIS ISSUE

ROD MILLS



DESIGNED by engineers who are familiar with the work for which the machine is intended.

PERFECTED by careful research, experimentation and co-operation with our customers.

FURNISHED where continuous operation and economy are the first considerations.

FABRICATED with the usual high grade material and workmanship that characterize all ALLIS-CHALMERS products.

ALLIS-CHALMERS, only, can offer complete motor-driven units with undivided responsibility of one manufacturer.

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

Volume 123 New York, May 14, 1927 *Number* 20

Curtailment of Metal Production Important

AS INDUSTRIAL ACTIVITY WANES, following a period of great business prosperity, the spectre of overproduction always appears. The mines, the farms, and the factories have become accustomed to maximum production and they are not inclined to curtail until stocks begin to build up to such an extent that a lessened production is the only obvious remedy. In fact, many producers will actually increase production, counting on a smaller unit profit from a larger production in order to prevent a decrease in their earnings, and leaving the marginal producer to get along as best he may. Such a policy is, of course, purely selfish; but altruists are few in any industry.

That the United States has had several years of unusual business prosperity is well understood; that industrial activity is waning is not so evident, for the usual "indicators" are mixed. Automobile production is not so great as it was last year, for example, but engineering construction — sewers, bridges, excavating projects, streets, roads, and public buildings—is going ahead at high speed. All in all, the current year is likely to see greater activity in the first half than in the last half. The threat of overproduction—both real and potential—is already receiving a great deal of publicity, especially with regard to non-ferrous metals and farm products.

Overproduction of copper has long been discussed; for some years it has been potential overproduction rather than real overproduction, but it has affected the market none the less and is likely to continue to affect it until the consumption of copper expands to the point where present facilities are all utilized in meeting the demand. This would appear to be some years in the future. In the meantime, production must be carefully controlled, and in the last month or so many large producers have taken definite steps in this direction.

With lead the situation up to now has been quite different: capacity production has been necessary for some years to meet the demand, and the prospect of a dearth of future supplies has caused serious thought. Now, demand has very evidently decreased, but the old production rate has been maintained even though lead prices have dropped from a high of 9¾c. to about 6¾c. Zinc is in much the same position. World zinc production in 1926 was the greatest in history, and the monthly average for the first three months of 1927 has been well above that of a year ago as well as above the average rate for 1926. Likewise with silver: the silver production of the world last year was the greatest in history, and no particular curtailment is yet evident.

The metal-producing industry has the benefit of a large amount of statistical information on production, consumption, and trade movements. Many organizations are engaged in this work: the U. S. Bureau of Mines, the Bureau of Foreign and Domestic Commerce, and the Geological Survey, at Washington; the Imperial Institute and the Imperial Mineral Resources Bureau at London; the Metallgesellschaft in Germany, and the American Bureau of Metal Statistics in New York. No excuse can be offered for not knowing the true state of affairs in the metal industry. Compared with the agricultural industry, it has the benefit not only of a more thorough knowledge of fundamental conditions, but also of more centralized control of production through large and powerful groups. They must, if metal markets are to be maintained and the mining industry is to be kept at recent levels of prosperity, curtail production in accordance with existing demand, adopting a broad and far-seeing view of the situation. Each will thus gain in the end. No policy of restriction to maintain unjustly high prices is advocated of course; such a policy is abhorrent to the government and to economists alike. But a policy of restricting output to accord with economic needs is wise; the individual producer should give it more consideration for his own ultimate good and think less about what the other fellow is going to do.

Diverse Views on Exploitation

WHEN citizens of the United States go abroad with their capital, their technical skill, and commercial ability, it is the natural play of the forces of civilization. "It is the method by which the more prosperous and improved portions of the earth help to bring these advantages to the less fortunately circumstanced. This policy is distinctly one that is in harmony with the law of service. In principle it is the method by which stronger communities minister to weaker communities." Thus spoke President Coolidge on April 25 before the United Press Association.

"But," said the President, "these operations must be carried on with justice and humanity. They must not be permitted to sink to the level of mere exploitation. They do not justify a seizure, which is virtually by force, of the natural resources of foreign countries. . . . Unless they rest on justice and fair dealing they are bound to fail."

In contrast to the President's words on exploitation those of Dr. C. K. Leith at the recent manganese meeting in Cleveland are interesting. He said:

"Even some of the people who take it for granted that manganese must be secured (from abroad) will at the same time oppose 'economic imperialism,' or 'exploitation,' or interference with other nations without realizing the contradictions in their attitude. . . . This confusion is not surprising. Governments have seldom been frank in explaining foreign exploitation. When they find it necessary to use pressure, political or military, it is almost uniformly announced as 'protection of national interests,' without explaining how or why these interests happen to be there. . . . Almost never have they clearly and frankly stated that exploitation was an inevitable consequence of the way in which material civilization has adapted itself to resources."

Having plunged in thus deep, Dr. Leith went still

deeper: "What is needed," he said, "is a clear understanding that nature's distribution of resources requires international exploitation of certain minerals, if our material civilization is to go forward along present lines; that whatever theoretical consideration of right or wrong are involved the movement cannot be stopped; that this requires the open door; that in some measure it requires the over-riding of national self-determination; that it is in fact a phase of economic imperialism, however objectionable this term is; and that dollar diplomacy is involved. The hypocritical attitude should be dropped that we are not and should not be doing these things."

The President gave utterance to the ideal. Dr. Leith was practical and spoke plain facts. Mr. Coolidge showed the path of virtue. Dr. Leith pointed out the path that the United States and other strong nations of the earth frequently have trod. The United States trod it in Panama and today is treading it in Nicaragua. But Dr. Leith argues that the nation should continue treading it. What would happen if the President's ideal were adhered to strictly? One fancies, glancing over history's pages, that the millennium would arrive.

When national necessity, real or fancied, finds itself in conflict with a moral principle involved in international relations, experience teaches that the national moral code is likely to be revised. This has been true of all the great nations in history and is true of them today. That fewer evidences of it are to be found in American history is, in part, because the United States' policy of isolation, with the aid of the Monroe Doctrine and the country's own great natural resources, has brought the nation face to face with fewer instances of need; and in part because this country's enviable position has permitted more rapid development of ideals.

The President's words meet with prompt response in the hearts of all. Instinctively we feel that he is right. Dr. Leith is practical, materialistic, and decidedly cold-blooded. The hope is that the future may see a nearer approach to the President's ideal. Perhaps a policy of giving full regard to the rights of small nations might pay, in indirect ways, more than it cost in loss of a concrete privilege.

The Geneva Economic Conference Opens

OVER on page 7, or thereabouts, of last week's newspapers, following several pages devoted to the current murder trial, one might have found a preliminary report of one of the most important international gatherings that has ever been held. The International Economic Conference, which opened its first meeting at Geneva on May 4, may well rank with the League of Nations and the World Court; in fact it may easily become more important than any other international gathering, for it is not unlikely that the financiers and business men may be more successful than the politicians and diplomats in securing world accord. After all, self-interest is the chief motivating agent for both individuals and nations; politically most nations think they will be better off if they assert their own rights and desires; economically, co-operation with other nations may seem more desirable.

Not a great deal is expected of this first conference, and yet it is highly important—so much so that the publishers of this magazine thought it worth while to send the Chairman of their Editorial Board to Geneva, his fist cabled report of the plenary sessions appearing on page 819. The delegates of the various nations will get acquainted, which is a primary essential in the amicable conduct of international affairs. They will learn each other's point of view. They will come back with a clearer vision of the difficulties, and they are many; some of them were alluded to in the early sessions. M. Theunis, of Belgium, for example, discussed the unfavorable effect of unduly high tariffs; Gustav Cassel, the Swedish economist, spoke about international restriction of production; Count Bonin-Longare brought up the immigration problem as affecting labor supplies; M. Shidachi, of Japan, dwelt on the freedom of international trade routes; Henry M. Robinson, of the United States, showed some of the reasons for American prosperity, suggesting simplification and standardization of product, and the increase of the purchasing power of the people. These are only suggestions of what is being discussed. The women are represented as well, for, as Frau Freundlich, of Austria, so convincingly pointed out, women constitute more than half of the human race; they have, she affirmed, a deeper feeling for international solidarity, and as housewives, help build the world's economic system.

Cerro de Pasco's Pumping Problem

ONE SHORTCOMING of many—perhaps most—articles published in the technical press is that they leave out any adequate account of the "grief" experienced by the operator. This is perhaps natural. The writer may feel that a recitation of his troubles suggests that he could have avoided them if he had used better judgment. As a matter of fact nearly every operator of a mine or mill, in the early stages at least, experiences many difficulties, and the intelligent reader knows it.

It is, of course, informing to know the methods and equipment that finally accomplish a desired result; but still more informing are the details of the development and evolution and of the successful procedure. Some philosopher has said, "We learn wisdom from failure much more than from success. We often discover what will do by finding out what will not do." Accordingly, an article that shows how problems have been solved and difficulties overcome is particularly valuable.

Such an article is that by George B. Dillingham, superintendent for the Cerro de Pasco Copper Corporation in Peru. The first part appears on page 796 of this issue and the concluding part will be published next week. At one time as much as 22,000 gallons per minute was being pumped in the process of unwatering the Morococha workings after they had been flooded. Seldom if ever has such a volume of water been handled through a single mine shaft. Moreover, in this instance it was highly corrosive. Mr. Dillingham describes the unavoidable flooding of the lower levels and in detail the subsequent two-year campaign to recover the workings. He describes the design of the pump stations, the water columns, and the necessary bulkheads; he gives the reasons for the selection of the pumps, electric motors and other equipment. He details the many setbacks experienced in the unwatering operations. One factor in the situation was the remoteness of the mines from plants where heavy equipment is manufactured. This imposes a tax on the resourcefulness of the engineer that is seldom realized by men operating in the United States and Canada.

Incidentally, emphasis is given to the progress made in the design of centrifugal pumps—particularly of the deep-well type—and of efficient electric motors for severe mine service. It is difficult to imagine how the results described could have been attained in anything like the time, had it not been for the modern equipment that is now available.

The author deserves the thanks of the mining industry for setting forth so fully the many details of the undertaking. Likewise the policy of the Cerro de Pasco officials in authorizing publication should be appreciated. The articles are a record of achievement under severe and unusual conditions. They reflect great credit on the staff in Peru, and should interest every engineer who ever expects to unwater a mine.

Natural Tendencies and Accidents

SHOULD a workman be given the opportunity to cause the same kind of an accident twice? an operator asks. Men are born with hereditary tendencies, he argues, and under certain conditions naturally act in certain ways, and sometimes an accident may result. Perhaps the offender will never again cause a similar accident, if he has time to think, the operator admits. But if the workman has no time to think, will the hereditary tendency assert itself and cause a repetition of the accident?

How, it may be asked, may one determine that the accident is due to a certain tendency in the workman if it be the first time that he has been responsible for it. Discharge him and the question as to tendency remains unsettled. Thus the operator's query amounts to asking whether a man should be let go for the first mistake—to which all will answer "No." It costs too much to train him.

On the other hand, the continued repetition of a bit of carelessness that may lead to a serious accident unmistakably reveals the existence of a particular tendency in the offender—a tendency toward thoughtlessness or worse—and whether this be due to heredity, early environment, or simply long habit makes little difference. The company will be better off without the man.

Iron Ore Prices Unchanged

EACH SPRING before the season's contract prices for iron ore are established one hears much the same story from producing centers. It is to the effect that prices for the new season are likely to be higher than in the year before. Evidently the wish is father to the thought, as it so often is. No advance has been made in iron ore prices since the spring of 1923. Declines occurred in 1924 and again in 1925; last year and this, the prices continued unchanged. The price fixed at the beginning of the season does not mean, of course, that all ore will be sold at that figure during the remainder of the year, for should a marked economic disturbance in the iron or steel industry take place it is conceivable that much ore might be sold at lower or higher prices. The fixed price does, however, apply to a considerable tonnage of contract ore and is usually pretty well maintained. Important variations in iron ore prices are unlikely to occur because contracts are made for deliveries far ahead and owing to the fact that large interests dominate the market, these interests being engaged in mining, smelting, and marketing the finished product.

By the Way

A PLAY by the name of "Spread Eagle" which opened in New York a few weeks ago, has a particular appeal to mining engineers. The first act takes place in the office of the president of the Spread Eagle Mining Co., at 120 Broadway, New York City. The second act shows the mine office in Mexico. The idea of the play is that revolutions in certain Latin-American countries may have inspiration from interests in the powerful nation north of the Rio Grande; and furthermore, that the stimulation of patriotic fervor is a very real occupation of interested parties who make full use of brass bands, moving pictures, and well-paid spellbinding. Not altogether satisfactory as a play, and overdrawn, of course, but it contains much food for thought, and as Benchley suggests in *Life*, it will make us give an extra half hour's consideration before enlisting in the next war for the defence of "all that we hold sacred."

J. F. CALLBREATH, Jr., Secretary of the American Mining Congress and Editor-in-Chief of our esteemed contemporary, *The Mining Congress Journal*, paid a friendly call the other day and told us the following story: Some years ago he was the editor of a mining paper in Denver and had established quite a reputation for the worth of his product. Showing a copy to a friend, he asked for a frank opinion. "It's no damn good," said he. Requesting an explanation, the somewhat abashed editor was told that his friend agreed with everything that he saw in the magazine, and thought it was fine; that therefore the paper must be representative of only the particular class of readers of which he was a member; and that a paper that broadly represented the industry must, of necessity, contain a few things that no one reader would like. It will be pleasant for us to think of this story when the kicks roll in.

POLITICS was not altogether absent at the Economic Conference in Geneva, even though it was a business men's affair. Representatives of Turkey and Soviet Russia were apparently regarded with the utmost suspicion. They were heavily guarded, each Soviet delegate having a detective at his heels, and they were forced to detrain ten miles from the Geneva station. They did not take kindly to this treatment at all, feeling that their being surrounded by guns was not so altogether to their interest as their would-be protectors tried to make out. After vigorous protest, says the correspondent of *The New York Times*, "the barriers were removed, except that a picket fence, strong enough to ward out chickens, remains stretched across the sidewalk in front of the hotel."

THE recent gold-rush fever in Nevada and Arizona was duplicated on a small scale recently in Los Angeles, when employees of the Southern Pacific Railroad started a wild hunt for nuggets, the first of which was found in the central station baggage room. The "vein" of shining nuggets ran a broken course in flooring cracks, and was dug out with knife blades, tweezers, nail files, and even finger nails. Nearly half a cupful was reported to have been recovered. The "mother lode," however, remained unlocated, but it is believed that some trunk passing through the department filtered its treasure through a split seam, and resulted in the "salting" of the baggage-room floor

Pumping Sixteen Thousand Gallons of Water Per Minute at Cerro de Pasco—I

By George B. Dillingham,
Superintendent, Cerro de Pasco, Copper Corporation,
Morococha, Peru

G. B. Dillingham

IN THE history of mining, a great many mines have been unwatered; but it is doubtful if any other similar undertaking has equaled, with respect to the extent of the area drained and the actual gallons of water pumped, the recent accomplishment of the Cerro de Pasco Copper Corporation at its Morococha mines, in Peru. These mines are situated almost due east of Lima, on the eastern slope of the Andes. In fact, the mineralized area extends to the very saddle of the divide, between the Pacific and the Atlantic watersheds. The district is almost surrounded by small glaciers, and numerous glacial lakes cover more than 600 acres of the district. The main drainage tunnel has a total of close to twenty miles of workings and passes about 400 ft. under Morococha Lake; and the upper lake, Huacracocha, is more than 750 ft. above this drainage level. This tunnel was started at the lowest available site, just as the upper end of Lake Huacracocha, which is about three miles long. A drainage tunnel at a lower level would require several miles to reach this district and accordingly was impracticable.

Water Always a Problem

As early as May, 1905, soon after A. W. McCune became interested in Morococha, he was advised that production would probably decrease, as the pumps in two shafts were giving trouble. At this time the shafts were not down more than 50 ft. below the surface of Morococha Lake.

Several shafts were sunk in the district, but the Natividad shaft was pushed ahead of the others. One can hardly imagine all the "grief" that has been gone through in the years of sinking these shafts. For years the only power was steam, produced by very poor coal. Blistered boilers and broken steam lines were common. Later fuel-oil helped some. Even when hydro-electric power became available, power lines were pulled down by heavy snowstorms. Lightning caused interruptions by breaking insulators; canals and ditch lines were washed out by floods.

All of the above troubles were not to be compared with the fight at the pumps themselves, the underlying reason being the large volume of water. The Natividad shaft was at least partly flooded about half of the time.

By the end of 1918 the Natividad shaft had reached the 1,000 level, but early in 1919 a strike caused the loss of the shaft to the drainage level. No attempt was made to regain the 1,000 level again until 1921. In the meantime, a protected pump station was built on the 750 level and considerable development work done. Water increased on this level, until by 1923 we were pumping over 10,000 gal. per minute against a 250-ft. head. During this time many air lifts were used when we were caught in difficult places. Frequently when the power was poor or pumps not working well the water rose 20 to 100 ft. behind our 750-level bulkhead gates.

The original plans of the 1,014-level pump station were submitted by an engineering firm in the United States. Some of the ideas were used, but many changes were made. Needless to say, a great deal of planning was done to make this station safe against any emergency, as well as to make it convenient to operate.

The Natividad is a two-compartment shaft from surface to the 1,000 level, with an 8-in. cable compartment at one end. From the 400 level down, there is a manway compartment at the opposite end. The shaft was equipped with a standard double-drum 100-hp. hoist, but during recent unwatering work the 100-hp. motor was changed for one of 200 hp.

Concrete Section Lining Unnecessary

One of the original proposals was to inclose completely with reinforced concrete the pump station and ventilation raise to the drainage level. A bulkhead gate would be provided to open to the shaft when necessary. As the station excavation showed the ground to be good tight monzonite, this was considered unnecessary. It was decided to timber the station with 10 by 10-in. timbers and then panel it, making the panels watertight against drip. The shaft was left open, whereas the ventilation raise at the back end of the station was equipped with a gate to control the ventilation. Plans submitted for consideration all called for ventilation fans, but it was found that the heat created by the motors escaped by the ventilation raise, making it upcast, and the shaft downcast. By means of the door on the ventilation raise alone, the temperature could be controlled and the station kept cool enough for comfort. The ventilation raise was equipped with good ladders.

After considerable study one water-tight bulkhead gate was decided on. This gate was placed well back of the station and on the 1,000 level. After the drift to the Central shaft (five compartments, well equipped) was completed this gate would be closed and the water entering the pump station would be controlled by valves.

Another problem was the valve bulkhead. The bulkhead gate was placed in the main heading, and a turnout was carried parallel, but 4 ft. lower. A second bulkhead equipped with four 14-in. valves was placed in this. All the water was diverted through this lower bulkhead. The approach to the valves was well protected with grizzlies to keep timber away from them.

After passing the valve bulkhead the water goes to

the screen chamber, where any trash larger than ¼ in. in diameter is left on the screens. Below the screens, the water drops into the sump, the bottom of which is about level with the section of the pumps, or 20 ft. below the 1,000 level. Several feet of water was always kept in the sump in order to give a pressure feed to the pumps, instead of a suction. The water entering the screen chambers can be excluded from either, to allow cleaning the screens.

The sump is 12 by 12 by 63 ft. while the ditch to the valves below the 1,000 level is 4 ft. deep by 7 ft. wide and 360 ft. long. This gives a total of about 150,000-gal. capacity. The sump usually contains 40,000 gal. In case of power interruption this allows eight minutes to shut the valves. There is 12 ft. of solid rock between the pump station and the sump, the only opening being the pump suction, which is in solid concrete. The suction to the pumps is 36 in. in diameter, and made of bronze.

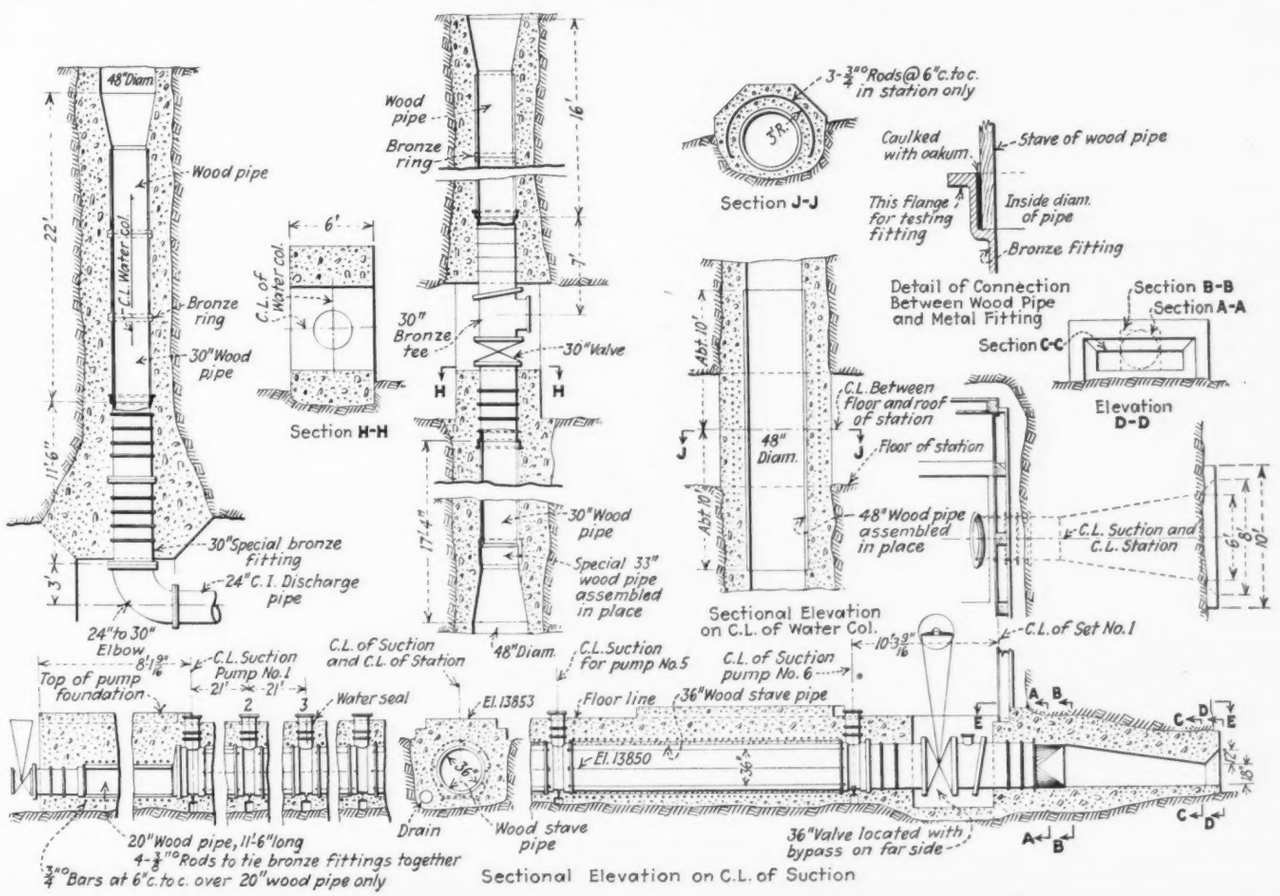
Bronze and Wood-Stave Suction Line

The suction line has a 36-in. valve just inside the pump station. On the sump side of this valve is a 6-in. connection to the station-sump pump, and a connection also to the main discharge column, in order to drain it back into the main sump. The 36-in. valve also has a 4-in. bypass valve. On the sump side of the 36-in. valve is a V-shaped section of pipe, 36 in. in diameter, that can be lifted out if it becomes necessary to enter the suction line under the pump station. The suction line under the pumps is bronze and wood stave, and is placed in solid concrete with a 14-in. valve at the shaft end.

The pump station is 168 ft. long, 18 ft. wide, and 12½ ft. high. It is timbered with 10 by 10-in. timbers, panels being fitted to make it water-tight. Any drip runs down behind the timber and thence to the station sump and is pumped back to the main sump. The station is equipped with six 4-stage centrifugal pumps, each guaranteed to pump 2,500 gal. per minute to the drainage level, 514 ft. above. Power is supplied by 500 hp., 1,200 r.p.m. induction motors. Each pump is equipped with a 10-in. gate valve on its suction, and a 10-in. check valve, followed by a 10-in. gate valve on its discharge. The 1,014-level station itself is 14 ft. below the 1,000 level at the shaft; and a track runs from the shaft directly into the station, and continues its entire length. There is a crawl with chain block over the pumps.

The discharge line originally was designed to go into the manway compartment of the shaft, and was to be wood-stave inside (on account of acid water), with a steel casing to be grouted outside, to give it strength. The entire column was to be concreted into the compartment.

We finally decided on a separate water raise, and after this was driven in solid ground we concreted it to 48-in. diameter, using collapsible forms 4 ft. long. The concrete for this was mixed on the drainage level, and dropped into place through a 6-in. pipe. Eight forms were used, and as soon as the lower section of 4 ft. was set, that form was uncoupled and lifted up through the others and placed on top for another ring. A small air hoist was installed at the top, and a small circular cage that three men could ride was provided. This cage would pass the forms when in place, and as soon as forms were removed the rough places were smoothed. At first we considered "cement-gunning" the column, but



Arrangement of suction and water-column for the 1,000-level pump installation

as the raise was in hard rock, this was not necessary. A short distance from the top the concrete water column was thrown to one side, leaving the top open for a steel door about 4 ft. above the maximum water level. The top of the column discharges directly into the quieting chamber of a weir. The lip of the weir is about 2 ft. higher than the drainage level, in order to prevent drainage water on this level from running into the column if power is off.

On the 750 level the discharge column is equipped with a 30-in. valve with a tee just above it. This allows the column to be used as a discharge for pumps from this level. This level might use the column and by shutting the 30-in. valve keep any water from going down the column to the lower station if the connections there happened to be open.

In November, 1924, we were pumping about 11,500 gal. per minute from our 1,014 station, and 2,000 gal. per minute from our 750 level, or a total of 13,500 gal. per minute. Of this, about 5,000 gal. per minute came from our 750 level past the Central shaft, 7,000 gal. per minute from the San Francisco veins on the 1,000 level, and 1,500 gal. per minute from the Central side on the 1,000 level.

Disaster on Thanksgiving Day, 1924

On Nov. 27, 1924, we lost the pump station on the 1,000 level as well as that on the 750 level. About the only good thing that can be said about this disaster is that no one was caught. The pump station on the 1,014 level was working well, and within a few weeks an accident, such as occurred, would have been impossible, as the work on the 1,000 level would have all been done from the Central shaft, leaving the bulkhead gate shut and allowing only such water as could be handled to pass the valve.

We thought at first that we might be able to hold the water below the 750 level; but all that we accomplished was the saving of some of the equipment. The story of the accident and of the unsuccessful campaign to hold the water by means of air lifts is interesting but too long to recite here. By April 7 we were compelled to abandon our skip pockets 65 ft. below the drainage level, as a consequence of a series of misfortunes.

After thorough investigation and study of the situation, the following equipment was ordered in January, 1925, to enable us to unwater the mines:

Two 24-in. four-stage, vertical turbine pumps, with cast-iron runners, to be driven by two 900-hp. vertical motors. Pumps guaranteed to deliver 10,000 gal. per minute each, at 120-ft. head, and 7,500 gal. per minute at 272-ft. head. Weight of each unit, complete, about 70,000 lb.

Two series pumping units, each composed of two 14-in. horizontal double-suction single-stage volute centrifugal pumps, mounted adjacent on base plate. Each unit to be operated by one standard 500-hp., 1,200-r.p.m. pump motor. Each unit guaranteed to pump 5,200 gal. per minute from the 750 Natividad station to the drainage level.

One 500-hp. 1,200-r.p.m. motor, with compensator and oil switch.

Seventeen hundred and forty feet of three-conductor 400,000-circular mil armored cable.

Four hundred feet of lead-covered cable as above, but not armored.

Three hundred feet of three-conductor No. 1 AWG copper cable, with lead sheath.

Six compensators, for 500-hp. induction motors, and such other new electrical material as seemed necessary.

The above, with the old equipment we could put in condition, we considered to be sufficient for the purpose.

The new equipment arrived in Callao, and was loaded on seven freight cars by March 14, 1925, but severe floods washed out the railroad and the material did not arrive in Morococha until after the middle of May. In the meantime, we had made everything ready to start on the installation of the deep-well pumps.

Deep-Well Pumps Ordered

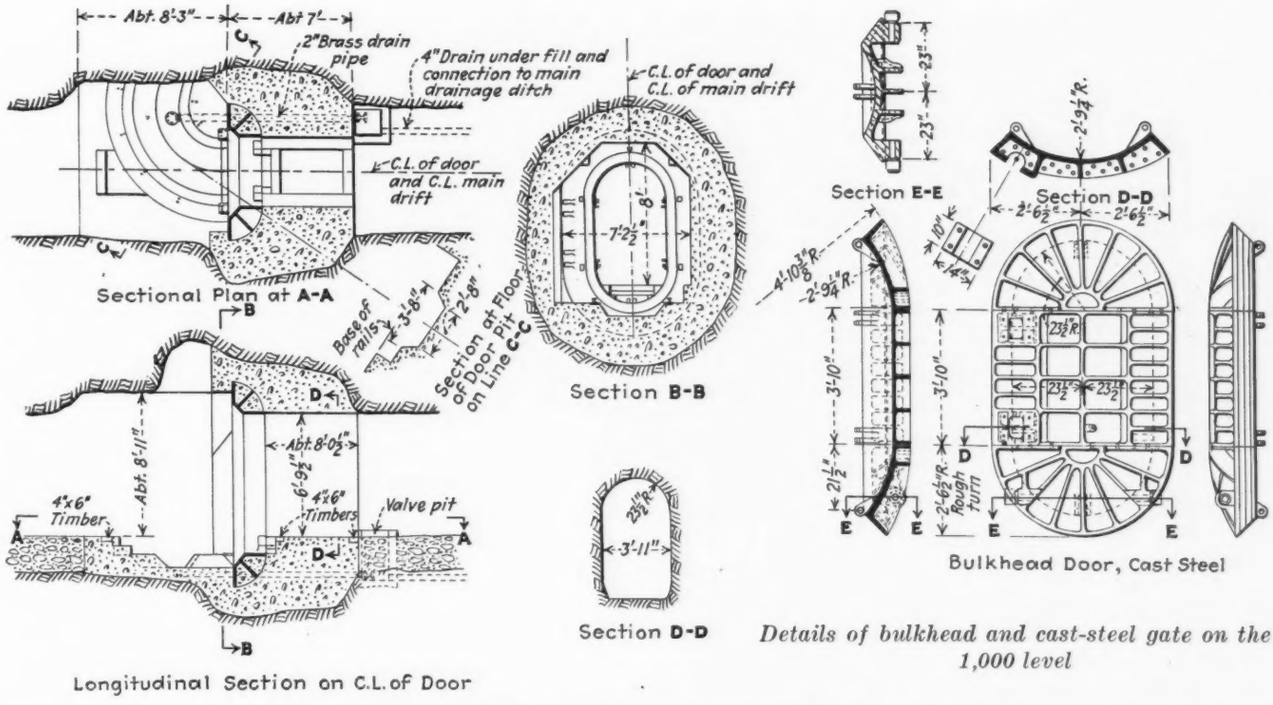
On the drainage level at the top of the pump-station ventilation raise, a hoist station had been cut and a heavy-duty air hoist installed. As each compartment of the Natividad shaft was to be used for a deep-well pump, a means would later be necessary to get materials to the 750 Natividad station. It was also at this time that the 200-hp. electrical equipment at the San Francisco shaft was exchanged for the Natividad 100-hp. equipment. The hoists are identical, except for the motors. As the deep-well pumps were to discharge onto the drainage level, the Natividad 500 station was considerably enlarged. A good platform was built for the starting equipment of two 900-hp. slip-ring motors, and sufficient space was left below this for the discharge of 20,000 gal. per minute from the pumps. Some water was passing this point on the drainage level, especially when air lifts operated at the Central shaft, so a quieting chamber, followed by an 8-ft. weir, was also constructed. The weir discharged directly into the drainage-tunnel ditch.

All water in the drainage ditch was measured at a weir situated further in. Also, about 300 ft. outside the portal of the drainage tunnel, a 10-ft. weir with a large pond above it was carefully constructed. The last-named construction proved to be the only dependable water measure on account of the velocity of approach at the 8-ft. weir below the deep-well pumps.

Each column, erected and ready to be lowered without the base plate, pump head, or motor, weighed about twenty-four tons. The pump bowls are about 24 in. in diameter, and the 16-in. discharge column has a maximum diameter of 26 in. The starter of the 900-hp. motor weighs about 8,500 lb. All other parts are lighter. Our 200-hp. hoist could and actually did handle all parts of these pumps except the column itself. Even this could have been done easily by erecting a solid block support and securing a pair of two- or three-sheave blocks. We saved much time and labor by having an 80-ton railroad wrecking crane, which not only unloaded and stored materials on their arrival, but delivered all heavy pieces to the shaft as needed and lowered and raised the 24-ton columns as required.

When the packing lists arrived we found each pump column to be 20 ft. shorter than had been planned. The spares that came with the pumps enabled us to add 20 ft. to one pump, but the necessary parts were cabled for, for the other.

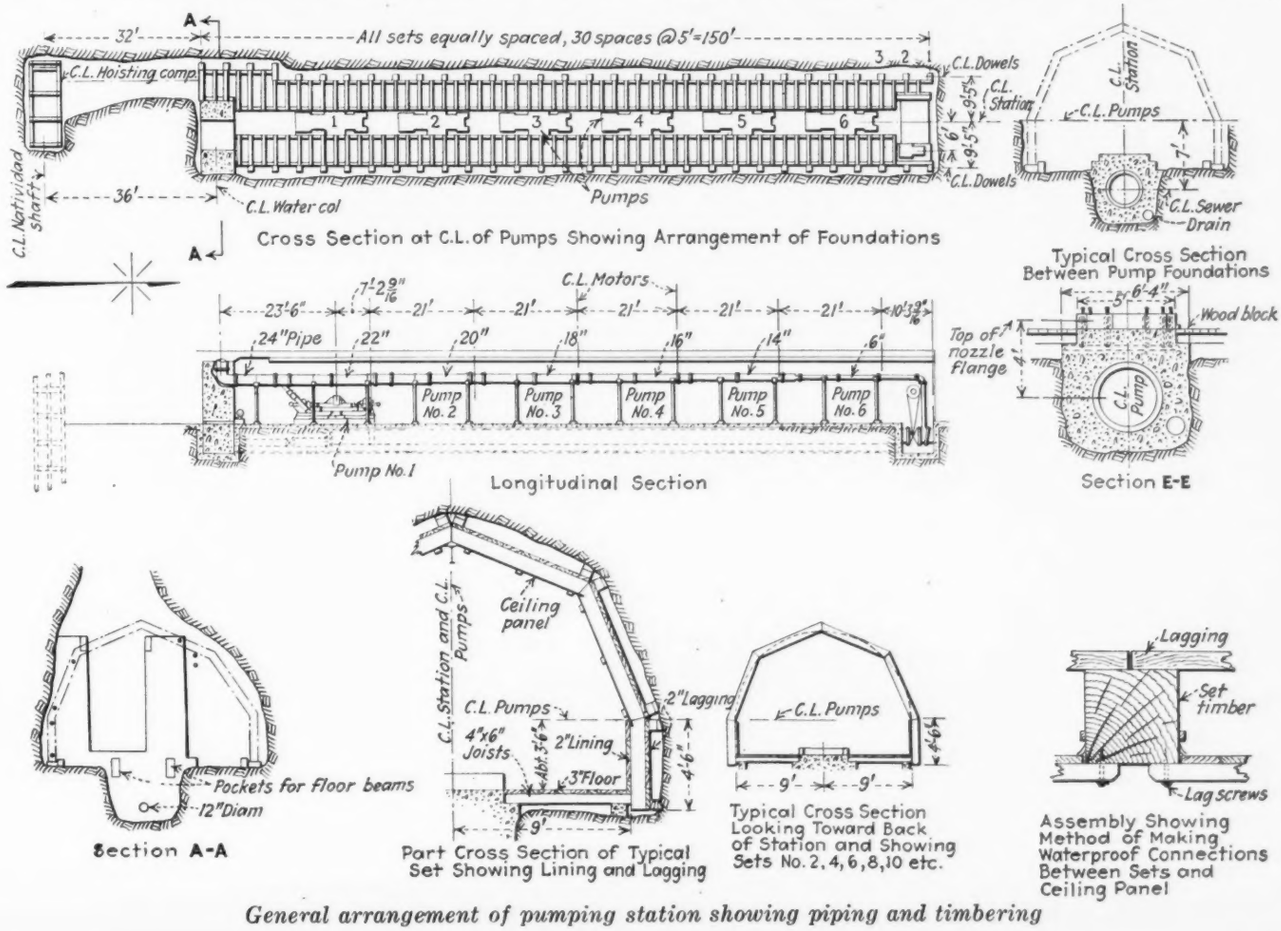
On the Natividad 500 level, erection platforms were made high enough so that when the pump base rested on the platform the 16-in. discharge line could still clear the floor of the station. The platform for each pump was made up of four 12-in. I-beams, plated together in pairs. These were 12 ft. long and rested in hitches back of the shaft and on 12 by 12-in. timbers in front. The shaft compartments are 5 ft. by 4½ ft. The pump bowls were placed on the platform, and then the entire column



Details of bulkhead and cast-steel gate on the 1,000 level

was erected piece by piece. The pump shaft is 4 in. in diameter, and came in about 20-ft. lengths. Outside the shaft was a 6-in. casing in 10-ft. lengths, the inside couplings of which acted as bearings for the 4-in. shaft. Next came the 16-in. discharge column in about 20-ft. lengths, with spiders at each flanged joint to support the 6-in. casing inside. Three crossheads, each about 5 ft. long, were made for each pump column to guide it on its way down the shaft. A clamp was made and placed below the first flange in the column above the bowls.

Two 1,500-ft. reels of 1¼-in. hoisting cable were now placed on surface, so that they would unreel into opposite corners of a compartment. Suitable anchors for supporting these cables were placed behind each reel,



General arrangement of pumping station showing piping and timbering

and a short piece of cable with clamps was passed under the reel to be attached to the cable as hung in the shaft in front of the reel. These cables were passed down the shaft and attached to the column clamp by the two clevices. Each clevice was tested to 60,000 lb. previous to installation. Two pieces of 1¼-in. cable were now cut about 75 ft. long and two pieces about 35 ft. long. The shorter pieces were clamped in each case to the longer pieces in such a way as to make two double slings. The

Deep-well pumps on the 750 level. That on the right is being dismantled

ends of the longer cable were now clamped to the cables that were to support the column. The top sling was looped over the crane hook; the shorter loop hung free.

After the pump column was lifted and the footpiece and screen were attached, the platform on the 500 level was removed and the entire column lowered about 40 ft. At this point two pairs of 12-in. I-beams were slid over the top of the shaft compartment on surface, and six 12 by 12-in. timbers were placed across them. In the meantime, the second double sling had been clamped to the supporting cables. Now the column was lowered until the short loop tightened on the six 12 by 12-in. timbers, which had been slid through the loop. The column was now supported and the crane could pull up and take a new hold. This same procedure would have been required if blocks had been used with the hoist as a source of power. Before the first vertical pump column was lowered intc place, an experienced erector arrived, and he approved the assembly. The pump was lowered to its position, which put its lower extremity about 14 ft. below the Natividad 750 level and its discharge below the pump base on the 500 level. Two of the three three-conductor, 400,000-c.m. cables formerly used carried power to this station.

UNWATERING STARTED ON JUNE 3

On June 3 the first deep-well pump started, and for the first few days delivered over 10,000 gal. per minute. Cooling water for the motor, as well as for the Kingsbury bearing, was furnished from surface.

In March, when we lost our 600 Central pump station, two 8-in. air lifts were left in one compartment of the Natividad shaft, and we now removed one of these without difficulty, but a pair of wooden clamps on the second hung up about 125 ft. below the drainage level, and the column could not be removed.

As the water was being lowered steadily with one pump and air lifts, we intended to lower the water 125 ft. to the obstruction and to remove it before lowering the second pump. At this stage 16,900 gal. per minute was indicated as going over the weir at the surface. After the water had been lowered about 75 ft. the capacity of the deep-well pump decreased to a little less than 10,000 gal. per minute, but the water level continued to lower. An average of 5,500 gal. per minute was pumped by air lifts during this time. In fact, all air that could possibly be spared was used, a maximum of 7,000 gal. per minute being pumped on pay day, when the mine was idle.

On June 19 we were gaining a little over an inch an hour, and so put two 350-gal. per minute bailers to work in the San Francisco shaft, in an attempt to reach the 125-ft. point and remove the obstruction in the second compartment of Natividad shaft.

At 8 p.m. on June 20, after almost seventeen days of continuous pumping, our hourly measurement showed that the water had risen in the shaft from 113 ft. below to 111 ft. 8 in. below the level. The air lifts were working as usual, but the pump was throwing much less water. Thinking the suction might be clogged, in spite of a screen 10 ft. long, we shut down, and let the water run back through the screen to clean it. On starting up the pump took too much power, but pumped some water, which was dirty. A second attempt was made, and on starting up, no water was pumped at all; and, after the first few moments, the power dropped to only 15 hp. Had the shaft broken, or stripped its threads; were the pump runners broken, or was the suction completely clogged? None of us guessed the real trouble.

Only one thing could be done, and so it was decided to cut the second pump column at 130 ft. and lower it before removing the first pump. The only way to break a pump column was to disassemble it from the top.

The suction of the second pump was lowered about 6 ft. past the obstruction in its compartment. To let the bowls pass the obstruction the entire column had to go into the back corner of the shaft, and this threw the motor and pump head so far back that the back of the shaft had to be excavated considerably at the station level. At 6 a.m. May 25 this pump started and delivered more than 10,000 gal. per minute. On June 27 the first pump had been lifted clear of the water, and the screen and suction piece removed. A small piece of one of the impellers was found in the basket, or screen. This was worn very thin, and had evidently been broken, but even

then we did not realize what had happened. On June 29, at 7 a.m., the pump column had been dismantled, and the pump bowls were opened. The runners, as well as the diffusion vanes, were almost completely eaten up by copper-sulphate water. Much of the copper was still coating the runners. The second pump was shut down and dismantled, and was found to be in first-class condition.

During the early pumping days in Morococha, the water contained much copper sulphate in the monzonite area, but after a considerable limestone area had been opened up and the water from this area had been mixed with the more acid water, it was found that 10-in. steel pipes handling the water were not destroyed by the copper-sulphate content, but that a limonite coating formed inside the pipes when the water was forced through, even at 12 ft. per second. We were aware that the water standing near the San Francisco and Natividad shafts contained more copper sulphate than we usually pumped, but about 7,000 gal. per minute were flowing through the San Francisco station when we started pumping. Could it be that the various stopes that had been worked below the drainage level had become so oxidized that thousands of gallons per minute were now charged with sufficient copper sulphate to make so much difference, or had the tremendous velocity of the water made this difference?

All pumps used previously had been bronze, but no wear had been noticed on pump columns in recent years, until now. It is true that air-lift columns had worn some, but nothing to compare with what we now found. The 16-in. discharge column was pitted badly for its entire length, but especially just above the pumps. The 6-in. tubing was worn more than half through, near the spiders. The spiders were badly worn and the wedges holding the 6-in. tubing in the spiders were so badly worn that many had come loose and been pumped out. The water passed through this discharge column at about 24 ft. per second. Even at this rate of flow copper sulphate was left as a coating in some places. Samples of water taken from time to time always showed some copper sulphate, but never more than 0.0018 per cent. The water in Morococha Lake had almost twice as much copper-sulphate content, and seepage water from the San Francisco and Natividad dumps, which is used for precipitating cement copper, contained 0.2840 per cent of copper sulphate.

At any rate our problem now became one of protecting our equipment from destruction by corrosive water. New pump bowls were ordered, complete with runners made of acid-resisting bronze. The shaft itself was made of monel metal. Five stages instead of four stages were supplied from the factory. A great mechanical improvement was made in the pumps by the introduction of a disconnecting housing just above the pumps. This allowed the pumps to be detached from the discharge column without disassembling the pump column from the top down.

Complete 6-in. tubings were rubber covered and the disconnecting housing was rubber-lined. Bronze spiders were used. At the joints of the 6-in. tubing a short space was not rubber-covered, and rubber bands with rubber cement were furnished for these spaces, as well as rubber sleeves to fit over the bands. These bands and sleeves proved absolute failures. The velocity of the water was so great that every rubber band and sleeve was torn loose and carried to the spider above, where it caused more friction. The 16-in. column had

Golf at Cerro de Pasco

A first-class course offers relaxation between periods of tribulation—whether unwatering the mine or something else

been badly eaten, but we decided to try an acid-resisting paint. The insides of the discharge columns of the two pumps were thoroughly sand-blasted and then painted with a priming coat, followed by a patented, heavy acid-resisting paint, which was applied hot. The results obtained with this protective covering were quite remarkable; and, had its qualities been realized before, as they are now, it would not have been necessary to cover with rubber the 6-in. tubing.

By July 12 the water was again flowing over the San Francisco station at the drainage level, and by November over 11,000 gal. per minute was flowing over this station.

(*To be concluded in the May 21 issue*)

South African Mines Still Depend Largely on Foreign Supplies and Equipment

In his annual report, Sir William Hoy, general manager of the South African Railways, gives some interesting data on the volume of purchases made by South African mining companies in the fiscal year ended March 31, 1926. The report is abstracted in *The Mining and Industrial Magazine*. Stores and materials of South African origin or manufacture consumed by the mines totaled £8,340,000 ($40,000,000), compared with £4,875,000 ($23,500,000) imported.

The purchase in oversea markets of machinery and supplies, the general manager states, cannot be avoided, and this position will continue until there is greater industrial expansion in South Africa. The main importations of the mines are:

Machinery and spares	£1,200,000
Rock drills and spares	369,000
Steel	334,000
Cyanide	286,000
Oregon pine	260,000

Among local purchases are the following (excluding the value of material imported from oversea used in manufacture):

Agricultural produce (including mealie meal, meat, and similar commodities)	£1,110,000
Mining timber	586,000
Explosives	1,465,000
Electricity and compressed air	1,868,000
Coal	1,038,000
Sundry commodities of South African origin (bricks, candles, carbide, lime, cement, concrete pipes, paint, soap, stationery, water, wire ropes and like materials	4,260,000

The purchases by the gold mines are on a much greater scale than are those of the railways.

California Produced 21,598 Bbl. of Oil Daily in 1926

The average annual production of the oil wells of California in 1926 was 21,598 bbl. a well, and this would fill a cube 49.5 ft. on an edge; average daily production of 614,019 bbl. would fill a cube 151 ft. on an edge; 1926 production, 224,117,013 bbl., would fill a cube 1,043 ft. on an edge; and the 1926 estimated production of the United States, 775,000,000 bbl., would fill a cube 1,632 ft. on an edge.

California accounted for almost 29 per cent of the total United States production in 1926. The ten important fields of the state in order of production were Long Beach, Midway-Sunset, Huntington Beach, Santa Fe Springs, Inglewood, Ventura Avenue, Elk Hills, Dominguez, Coalinga, and Fullerton. Collectively these produced 175,842,784 bbl. in 1926 and 180,217,038 bbl. in 1924. Of the ten, five showed increased and five decreased production. The most marked increased was the Inglewood field.

Ownership and Operation of Lake Superior Iron Ores in Fewer Hands

By Dwight E. Woodbridge

THE 1927 analysis book of the Lake Superior Iron Ore Association has just been issued. It presents some interesting food for thought. A total of 183 iron "ores" are listed, plus seventeen that are classed as "inactive." Ten years ago there were 327 "ores," with none inactive. Casually looked at, these figures show a really startling situation. Does it mean that there are only 56 per cent as many iron mines operating as there were in 1917? Fortunately, not at all. That there has been a considerable shrinkage in the number of mines is true; 522,000,000 tons cannot be taken from a district without some exhaustion. But what these figures really mean is that there has come about a marked concentration of ownership and operation into few hands, that there is less recognition of individual properties, and that there is far more care in grading ores for their ultimate destination than there was. As to this last, it, at least, is a distinct advance in metallurgy.

This concentration of operations is more pronounced on the Mesabi than elsewhere; a recent canvas of operators there failed to disclose more than two or three actual independents whose production is large enough to amount to anything. The word independent is not intended here to imply what it has come to mean in steel, but represents a miner who sells on the market at least a considerable part of his output and is not identified, either by financing or by long-term contracts, with consumers.

In the matter of grading ores before shipment notable technical advances have been made. Naturally, this step was first undertaken by the chief operating company, for it had numerous mines, of diverse ores, its annual requirements were vast, and it had furnace specifications that could be somewhat standardized along rather definite lines. Not fewer than eighteen of its mines have contributed to one ore grade, and for years it has listed from six to ten of these grades, some of which differ from one another by only trifling percentages of one or more of their constituent minerals.

No doubt the commercial tonnage in mines which contribute to these groups is increased materially by this process of mixing. Low silica, high iron ores act as sweeteners for a lot of material that if shipped by itself would cause a howl of rage and despair clearly audible without radio aid from Pittsburgh to Duluth.

One Cuyuna miner recently assembled several unsuccessful and abandoned mines, which it was impossible for their separate owners to operate. Some of the ores were no more than reserves for future consideration—what the state called "low-grade non-merchantable material." Four properties were combined, as operations under unified control, and a worth-while tonnage was added to the Cuyuna's total.

This was not all so easy as it sounds; so to consolidate uneven tonnages of more or less spotty materials as to bring about distinct, definite, and salable grades of iron ore, and to do this within the rigid and narrow limits permitted by the price for ore, was no suant problem. These particular ores originally varied from high to low in iron, manganese, and silica. Still another way to increase tonnage and cut costs has thus been shown and an opportunity provided for speculation as to what this may mean in the future.

Africa's Iron Ore—An Unknown Quantity

Over 80 Per Cent of Present Estimated Tonnage Is Controlled by England, and the Balance by France and Spain

By Olin R. Kuhn
Donner Steel Co., Buffalo, N. Y.

Olin R. Kuhn

LITTLE IS KNOWN of the iron-ore resources of Africa. This great continent covers an area of about 11,515,000 square miles and has a population of 180,000,000 people, but although it is one of the largest continents in area it is one of the smallest in known iron-ore resources. Aside from some deposits in the northern part of Africa along the Mediterranean Sea, in the south in the Union of South Africa and Rhodesia, and in the west in Togoland and Nigeria, there are practically no known iron-ore deposits of economic importance. It is quite possible that Rhodesia and West Africa contain large tonnages, but the available reserve of iron ore known at present is estimated at less than 1,500 million tons. As the central parts of Africa become better known it is probable that some large and hitherto unknown orebodies will be found. Sjogren and Eckel state that the iron-ore reserves of the known regions of the world average about 1,650 tons per square mile of area, and if this assumption is applied to Africa one might expect to find some 19,000 million tons of ore there, which is many times the actual amount known at present.

Africa probably produces between two and two and a half million tons of iron ore annually, practically all of which is mined in northern Africa. No iron industry exists in the continent except in the Transvaal, where a little ore is smelted in local furnaces, yielding about 1,000 tons annually. These at present are not operating, and the ore that is produced is exported to England, Germany, France and the United States. Some steel is made from imported iron in the Union of South Africa.

Table I—Iron Ore Production of Africa

	Northern Africa			Southern Africa		
Year	Algeria	Tunisia	Morocco	Rhodesia	Transvaal	Belgian Congo
1913	1,348,900	597,500	.....	.....	.....	.....
1914	1,115,000	520,700	.....	.....	.....	.....
1915	818,700	285,900	189,200	8,600	.....	.....
1916	1,042,900	500,900	267,700	5,200	.....	.....
1917	985,300	606,000	(a)	4,800	.....	.....
1918	902,500	421,500	262,500	5,800	4,400	.....
1919	735,600	354,700	269,400	2,300	3,300	.....
1920	1,071,300	406,300	211,900		2,300	73,200
1921	720,800	265,700	115,500		2,200	73,200
1922	1,045,800	496,800	300,100		1,900	71,300
1923	1,452,600	845,000	396,700		500	105,800
1924	1,622,500	797,700	(a)		....	105,200

(a) Not available.
Note—Above tonnages only approximate, as some tonnages show exports instead of production.

Although the deposits in the northern part of Africa, in Algeria, Tunisia, and Morocco, are not the largest found in Africa, they are by far the most important in regard to production, and more than 95 per cent of the entire iron-ore production of the continent is mined in these three countries.

Algeria

Algeria is probably the most important of the French colonies as a producer of iron ore. This is due largely to its location and the number of known deposits within easy reach of the sea coast. Transportation facilities extend along near the coast and connect the mines with the shipping ports.

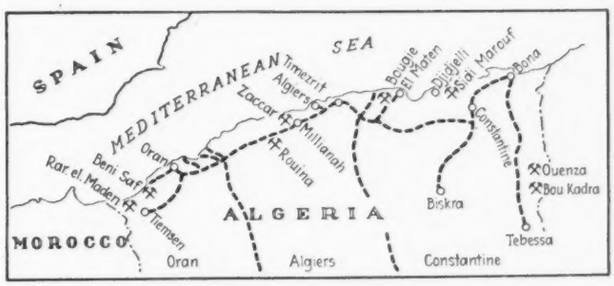
The iron-ore deposits are for the most part found in limestone, either intercalated in it or near the contact with schists. The principal deposits are of red or brown hematite ore, easily smelted, and sometimes self-fluxing. The ores are usually high grade and contain some manganese. Small deposits of magnetite have been found and worked, but are of little importance.

The entire country of Algeria is divided into three states or departments, Constantine, Algiers, and Oran.

Department of Constantine.—Ouenza, the largest and most important mine in Algeria, is situated in the Department of Constantine, near the Tunisia frontier. The Société de l'Ouenza, a French company, took this mine over in 1913, but it did not start mining until 1921. Since that time production rapidly increased to 700,000 tons in 1925 and it is expected to reach about one million tons in 1926. The ore, Ouenza-Companil, is a red hematite averaging about 56 per cent in metallic iron and 2 per cent in silica and manganese. It is shipped to Bona for export. The reserve of this deposit is estimated at 45,000,000 tons, although it will probably prove much larger on further exploration.

The Ouenza company also owns the Bou Kadra mine, 12 miles to the south, which contains the same grade of ore as the Ouenza. This mine is expected to be in operation by 1929 and is equipped to produce 500,000 tons of ore annually. The reserve of the Bou Kadra is estimated at 15,000,000 tons.

The Timezrit mine, near El Maten, produces from



Sketch map of Algeria, indicating the location of the iron-ore deposits

Outline map of Africa, showing location of ore deposits

100,000 to 150,000 tons of lumpy high-grade hematite ore annually. This ore carries 58.60 per cent of iron and 1.20 per cent of manganese and is very low in sulphur and phosphorus. It is exported from Bougie. The Affalou and Beni-Felkai mines are near by, and also ship from this port, but their output is small.

Considerable ore has been mined from the Mokta-el-Hadid company's mines in the Ain Mokra region near Bona and from the Marouania mine, but with the exhaustion of the surface ore, and the necessity of mining underground instead of by open pit, these operations have been shut down. The Sidi-Marouf deposit lies near Constantine, but as yet has not been opened.

Although little is known as to the occurrence of iron ore in the central part of the Department of Constantine, the known deposits near the coast and the Tunisia frontier are estimated to contain at least 60,000,000 tons of proven ore.

Department of Algiers—The Yebel Zaccar and Milliana mines, west of Algiers, are the most important ones in this department, and contain a mixture of red and brown hematite ore with some traces of carbonate. Prior to the war they produced 150,000 to 175,000 tons annually, but since then have shown little activity. This ore is not as high grade as the ores in the Department of Constantine, as it carries only about 45 per cent of iron. The Rouina mine, slightly further inland, has been extensively developed and can now produce over 100,000 tons per year. This ore average about 53 per cent in metallic iron.

Production at the Temoulga mine has been variable, on account of the quality of the ore, which carries only about 46 per cent of iron. Some years as high as 50,000 tons has been mined. Ore occurs at Djebel-Hadid, near Cherchel, but the mine has been worked only intermittently and on a small scale.

The ores of the Department of Algiers are of red and brown hematite carrying from 45 to 54 per cent of metallic iron. No figures are available as to the reserve in this department, although it is known that the tonnage is fairly large and that the territory south of the railroad has not been explored.

Department of Oran—The Department of Oran lies between the Department of Algiers and the border of Morocco. The Beni-Saf mines are probably the largest in the district. These are controlled by the Mokta-el-Hadid company and have produced more than 10,000,000 tons of red and brown hematite ore containing from 45 to 57 per cent iron. This ore is shipped to the private dock of Beni-Saf, on the coast, for export.

Rar-el-Maden mine has been worked since 1898 and ships about 50,000 tons of ore annually. Its ore is manganiferous, carrying about 47 per cent iron and 4.50 per cent manganese.

Sebabna mine, in the extreme western part of the Department of Oran, also contains manganiferous ore. This ore is a mass of red and brown hematite carrying over 6 per cent of manganese.

Kristel mine, near Arzew, was operated from 1905 to 1915, and about 400,000 tons was mined, but it has been shut down for more than ten years. This ore is lumpy. It is also very low in grade, averaging only 33 per cent in iron and 20 per cent in slime content.

No estimate is given of the available reserves of iron ore in the Department of Oran. The ore now being mined is taken from open cuts, and it will be some time before it will be necessary to resort to underground mining.

Table II—Analyses of the Iron Ores of Algeria (in Percentages)

Department	Mine	Iron	SiO_2	Mn	P	S	Lime
Oran	Sebabna	49.10	7.10	6.25	0.071	0.108	3.00
	Rar-el-Maden	47.00	4.25	4.50	.020	.040	.30
	Beni-Saf (Hamed)	49.77	5.15	1.04	.032	.022	8.00
	Beni-Saf (Brika)	52.17	5.35	.90	.031	.019	6.55
	Beni-Saf (Tafna)	57.00	4.60	1.01	.034	.022	3.50
	Arzew	33.00	2.50	.80	.028	.030	20.00
Algiers	Djebel-Hadid	54.16	3.63	1.35	.077	.013	4.29
	Temoulga	46.00	5.00	1.30	.030	.050	7.50
	Rouina	53.00	6.00	.60	.025	.080	3.00
	Zaccar	54.95	5.07	1.25	.018	.030	6.50
	Fondouk	51.70	.....	2.49	.030	.020	2.52
	Ain-Oudrer	49.32	19.19	.04	.730	.032	5.36
Constantine	Timezrit	52.00	4.00	1.30	.013	.020	2.00
	Affalou	52.00	3.00	1.25	.012	.030	2.00
	Beni-Felkai	48.39	1.54	1.50	.008	.017	4.17
	Marouania	53.72	3.31	1.74	.010	.220	4.63
	Bou Kadra	58.17	3.19	2.38	Low	.061	
	Ouenza	56.19	1.67	1.90	.006	.085	2.26

Information as to the reserve of the individual deposits of iron ore in Algeria is lacking, but the Imperial Mineral Resources Bureau, of London, and others credit this colony with at least 100,000,000 tons of fairly good hematite ore, most of which can be taken out by open pit or quarrying methods.

Tunisia

Deposits of iron ore are distributed over the greater part of Tunisia, another French colony located to the east of Algeria, but apart from those of inferior quality or containing limited reserves, there are only three regions of importance—the Nefzas and Douaria district in the north, the Djerissa-Slata district near the Algerian frontier, and the Gafsa district further south.

Although the estimated reserve of iron ore in Tunisia is almost equal to that of Algeria, production is only 400,000 to 600,000 tons annually, the limited output being attributable to the unfavorable locality in which the orebodies occur. All of the ore mined in Tunisia is exported, mostly to England.

Nefzas-Douaria—The Nefzas-Douaria region is in the

northern part of Tunisia along the coast of the Mediterranean Sea west of Bizerta. In this area ore occurs in lenses of considerable thickness and width, usually at or near the surface, so that it can easily be worked by open cuts. The ore is under the bessemer limits in phosphorus and fairly high in iron. Most of the concessions either have not been developed or else have suspended operations at an early stage.

No mines are operating in the Nefzas district, because the ores are mixed with clay and require washing before they can be put on the market; also because they contain 0.5 per cent or more of arsenic.

In the Douaria district the only active operations are the Douaria and Raz-er-Radjel mines. The Douaria mine is equipped to mine 1,500 tons per day, and it is estimated to contain a reserve of over 6,000,000 tons of ore averaging 52.30 per cent iron, 7 per cent silica, 0.5 per cent lime, and 0.035 per cent phosphorus. The probable reserve in this mine is far in excess of the above proven tonnage.

Raz-er-Radjel mine is in the development stage, but the ore is similar to that in the Douaria mine. The mine contains a reserve of about 2,000,000 tons of proven ore. Ores from the Douaria and Raz-er-Radjel mines are exported from Bizerta.

Djerissa-Slata—The Djerissa-Slata district lies near the border of Algeria and is probably a continuation of the Ouenza and Bou Kadra deposits. At Djerissa the ore occurs as a red hematite replacing the middle Cretaceous limestones. The reserve here is placed at about 20,000,000 tons of available ore, all of which can be worked opencast. This mine is equipped to produce 500,000 tons annually, but because of transportation difficulties this tonnage has not been reached up to the present.

At Slata the ore occurs in pockets and lenses on the contact between the limestones and the marls with which the limestones are interbedded. The actual reserve of ore in sight in this mine does not exceed 500,000 tons, and it is being mined out at the rate of about 50,000 tons annually.

A deposit of iron ore is being operated at Hameima, but it is still in the exploratory stage. Other deposits are known near Harrala and Bou Jaber, but as the ore appears to be variable in quality and contains a mixture of impurities there has been little exploration.

Gafsa—In the Gafsa district, south of the Djerissa-Slata region, an extensive deposit of iron ore is known at Djebel Onk, which is estimated to contain 60,000,000 tons of ore. The ore beds here vary from 3 to 16 ft. in thickness, and the outcrop has been traced over a length of 5 miles. Samples taken from various parts of the outcrop show an average of 52 per cent iron, 1.95 per cent manganese, 6 per cent silica, and 1.25 per cent phosphorus. It is questionable, however, whether this deposit is of economic value at present, as it lies 65 miles from the coast and the ore is so friable that it would probably require nodulizing or briquetting before it was shipped.

Other deposits of iron ore are known and have been developed to some extent near Kef, in the valley of the Mellegue, but at present they are not in operation. The ore occurs here in a bed lying almost horizontally in the lower Cretaceous formation, ranging from 9 to 25 ft. in thickness, but little is known of the reserve in this deposit.

Many parts of Tunisia are still unexplored, but the total reserve of the known deposits can be taken at about 100,000,000 tons of available ore.

Table III—Analyses of the Iron Ores of Tunisia (in Percentages)

Deposit	Iron	SiO_2	P	S	Lime	Mn
Douaria	52.30	7.00	0.035	.....	0.50	....
Djerissa	55.02	1.35	0.013	0.008	4.13	2.32
Slata	48.50	3.00	0.012	0.027	6.00	3.00
Djebel Onk	52.00	6.00	1.250	.....	....	

Morocco

Northern Morocco is under Spanish rule, and the southern part is controlled by the French. The unsettled condition of the country has prevented prospecting except along the coasts, as neither France nor Spain has been able to bring its Moroccan territories actually under subservient control, and it has been dangerous for prospectors to go far inland.

French Morocco—Practically no operations have been carried on in French Morocco, although a few trial lots of ore were shipped to France: in 1915, 258 tons; 1916, 19,133 tons; and 1917, 16,998 tons. Since then nothing has been shipped.

Deposits of minor importance are known in the Atlas region to the east of Agadir, near Oudjda in the east, at Djebel Hadid north of Mogador, in the valley of the Oumer Rebia, in the Ida au Mahmoud, and in the valley of the Segsaoua. The deposits of Immingount, Djebel Figuermi, and Tagelt appear promising and have been developed to some extent by the natives, but are probably not operating now. Concessions for these mines are held by the Union des Mines Marocaines. Copper and barytes are found with many of the ores, which renders them not commercially desirable at this time. No reliable estimates are available respecting the reserves in the iron-ore deposits in French Morocco.

Spanish Morocco—Spanish Morocco produces from 250,000 to 400,000 tons of iron ore annually, most of which is exported to England. This country contains several important deposits of ore near Melilla, a pacified portion of the region on the Mediterranean Sea, and they are worked on a considerable scale. The ore usually lies at a steep inclination and occurs in masses as replacements in the limestones of the older rocks. It consists mainly of red or brown hematite and is usually a hard, dense, lumpy ore, and is worked by opencast methods.

Four companies operate mines in the Melilla district, and the ore is shipped to Melilla for export. The Cia. Española Minas del Rif, the largest company, operates the Uixan mine, the Setolazar company the Navarette mine, the Alicantina company the Alicantina mine, and the Norte Africano company the Afro mine.

The Uixan mine is situated in an isolated hill 3,000 ft. above the level of the Mediterranean and only 3½ miles from the shore of Mar Chico, a large bay. Five quarries have been opened on one side of the mountain,

Sketch map of Tunisia, showing the iron deposits

and they reveal deposits of high-grade ore from 800 to 1,000 ft. wide. These deposits have been tested to only a small extent. One of them has shown by drillings some 30,000,000 tons of high-grade ore averaging over 62 per cent iron, 4 per cent silica, and very low in phosphorus. This ore is almost pure hematite and magnetite, but contains considerable sulphur in places and should be roasted or calcined before it is shipped. The Uixan property contains some 5,000 acres, and the proven ore is only a small part of what may be expected on further development.

The Navarette mine is near the Uixan mine, but the ore is inclined to be lower in iron and more siliceous. The ore is a very dense hematite carrying about 54 per cent iron, 11 per cent silica, and 0.03 per cent phosphorus. This property, which embraces about 4,700 acres, is estimated to contain at least 4,000,000 tons of available ore. The Setolazar company ships its ore from the same dock as the Minas del Riff. Its mine produced about 80,000 tons in 1920.

The Alicantina mine, in the same district, is controlled by French and Spanish capital. The ore here is a lumpy hydrated brown hematite averaging about 50 per cent iron, 3.50 per cent in silica, and 0.03 per cent phosphorus, but there is also considerable lower-grade ore containing 48 per cent iron. This property only contains about 48 acres, and is estimated to have a reserve of only 1,000,000. The Afro mine contains manganiferous ore carrying 48.50 per cent iron and 4.20 per cent manganese.

Other occurrences of iron ore have been reported by natives from many parts of the unpacified zone west of Melilla, and some of the samples brought in show the ore to be high grade, but on account of the inaccessibility of the district little or nothing is known concerning them.

Table IV—Analyses of Iron Ores of Spanish Morocco (in Percentages)

Mine	Ore	Iron	SiO_2	Mn	P	S
Uixan	Uixan	63.64	5.97	0.06	0.026	0.109
Navarette	Navarete	54.00	11.00	0.50	0.030	0.100
Alicantina	Alicantina	50.00	3.50	1.60	0.030	0.030
Afro	Morocco Mang	48.50	7.50	4.20	0.040	0.060

Although the known iron-ore resources of Spanish Morocco total only 35,000,000 tons, the probable reserve is much larger, and it would probably be conservative to put the actual reserve of Spanish Morocco at about 50,000,000 tons of available ore.

Total iron-ore reserves of northern Africa can be taken at about 250,000,000 tons of available ore, as shown in Table V.

Table V—Iron Ore Reserves of Northern Africa

Algeria	100,000,000
Tunisia	100,000,000
Morocco	50,000,000
Total	250,000,000

Belgian Congo

Iron ores are scattered throughout the Belgian Congo, but owing to the relative inaccessibility of the deposits, comparatively little attention has been paid to them, and only a small amount of information concerning their character is available. The most promising deposits occur in the southeast part of Katanga, and are probably an extension of the South Africa and Rhodesia deposits. Here the ore is hematite and magnetite, which has been altered to limonite near the surface. Some of the ores are reported to contain 65 per cent of iron. The prohibitive cost of exporting these ores has prevented development.

The Kasai region, on the slopes of the Angolan plateau, contains deposits of hematite and magnetite ore of low grade, running from 32 to 56 per cent iron and somewhat resembling those of the Vermilion range in the United States. Other deposits are known to exist in the Welle region and in the Maniema and Kale Vivu region in the eastern part of the country, but there is little information regarding them.

Recently some ore has been produced in the Belgian Congo. Little is known, though, regarding the reserve tonnage or the quality of the ore.

French West Africa

French West Africa comprises the colonies of Senegal, French Guinea, Ivory Coast, Dahomey, French Sudan, Togoland, and Mauritania. Iron ores are fairly abundant in these colonies, but the deposits have not thus far been developed except in the most primitive manner by the natives. French Togoland, taken from the Germans in 1914, contains the only deposits about which any details are known.

Important deposits of massive hematite occur at Banyeli, in French Togoland, in association with conglomerates and sandstones of sedimentary origin. Koert estimated the reserve of these deposits to be not less than 20,000,000 tons of ore containing 50 per cent iron, but recent investigations have indicated that the tonnage is much higher than this figure. However, these deposits are 235 miles from the coast, and exploitation of the ore is not economically possible at present. The analysis of Banyeli (Sokode-Bassari) ore may be given as follows: Iron, 50 per cent; SiO_2, 9.47; Al_2O_3, 0.24; S, trace; and P_2O_5, 0.3.

Laterite ores occur in French Guinea, French Sudan, and the Ivory Coast, but nowhere in any abundance. Titaniferous magnetites and hematites are known to exist in Upper Dahomey, but they are a considerable distance from the coast, and little is known concerning them.

British West Africa

British West Africa includes the colonies of Gambia, Sierra Leone, Gold Coast, and Nigeria, and iron ores occur in all of these colonies, but the deposits in the Sierra Leone and Nigeria are the most important.

Sierra Leone—Several deposits of lateritic iron ore are found in Sierra Leone, the largest being near Devil Hole, where the ore forms a belt about 1,500 ft. wide which can be traced for three miles. The ore has a proven depth of 8 ft., and probably continues to a much greater depth. It is estimated that there is well over 3,000,000 tons of ore in the Devil Hole alone, which should average about 60 per cent iron and from 2.80 to 21.50 per cent in titanic acid.

Other deposits of lateritic ores and titaniferous magnetites are known on the Koinadugu plateau and on Bathurst Mountain which carry over 45 per cent iron, but they have not been developed, except locally by the natives.

Nigeria—The most important iron-ore deposits in Nigeria are those of Mount Patti, a hill rising 1,050 ft. above the level of the near-by river, in the northern part of the country. The ore occurs on the summit of the hill, which is several miles in area, and is generally a limonite or a brown ore. The beds total 75 ft. in thickness and cover an area of about 10 square miles. It is estimated, but not proven, that there is about 2,000 million tons of 50 per cent ore in these deposits that can easily be worked open cut, as the overburden is com-

paratively thin. Though these deposits are favorably situated for exploitation and transportation, the ore in the above-mentioned tonnage, since it is not proven, can be taken only as a possible reserve.

Gambia—Lateritic ores occur in cliffs along the banks of the Gambia River which contain from 25 to 35 per cent iron and from 28 to 45 per cent silica. These ores should be mined cheaply and be easily transported. Although they are not high in grade, they should prove valuable in the future.

Gold Coast—Small deposits of limonite and hematite, containing from 52 to 64 per cent iron occur in various parts of the Gold Coast colony. Although they have been smelted at times by the natives, the deposits are small and of no economic value at present.

Togoland—The Akpafu iron-ore deposits are in the part of Togoland belonging to the English, and the ore, as a rule, is low in grade and siliceous. These deposits were operated at one time, and the ore was smelted locally, but none has been taken out for some time.

Table VI—Analyses of the Iron Ores of British West Africa (in Percentages)

Country	Deposit	Ore	Iron	SiO_2	P	S	TiO_2
Sierra Leone	Devil Hole	Laterite	59.91	.....	.....	.....	12.00
Nigeria	Mt. Patti	Pebbly	33.78	20.40	Trace	0.090	.....
		Laterite	46.66	8.70	0.035	0.008	.....
		Pisolite	54.81	3.20	1.070	0.080	.....
		Limonite	56.29	0.35	1.350	0.070	.....
Gambia		Laterite	25–35	28–45	.....	.....	.....
Togoland	Akpafu		35–48	19–46	0.020	0.025	.....

Nyasaland

A small deposit of hematite ore is found on the Mvai and Dzonze ridge, in Nyasaland, in British East Africa, which contains about 69 per cent metallic iron and is low in silica and sulphur, but the ore in sight in estimated at only 53,000 tons. Deposits of magnetite and brown ores are known to occur in Nyasaland which carry 45 to 70 per cent iron, but little is known concerning them. Deposits of ore have been reported in Uganda and Tanganyika, but no data are available as to quality or quantity.

Madagascar

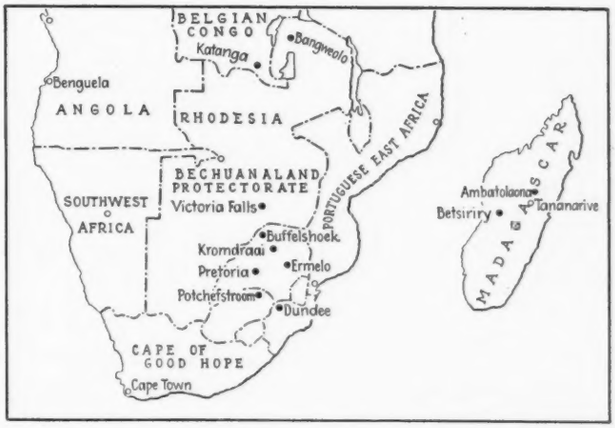
The Island of Madagascar, a French colony in the Indian Ocean off the coast of Portuguese East Africa, contains several fairly large deposits of iron ore. The ore is generally high-grade magnetite containing about 65 per cent metallic iron. In the Ambatolaona region some exploration has been done proving up over 200,000 tons of ore, and the government has estimated that there is at least 4,000,000 tons of ore in this deposit. In the Betsiriry district, on the Vongoabe River, deposits of titaniferous ore occur which are estimated to contain over 3,500,000 tons.

Practically no development of the iron ores in Madagascar has been accomplished, and the reserve, although probably much larger, can conservatively be placed at 7,500,000 tons. A little ore has been mined in Madagascar, but the production has been insignificant and the exports do not average more than thirty tons a year.

Union of South Africa

The Union of South Africa, controlled by the British, contains probably the largest known iron-ore reserves in Africa. This district includes Cape Province, Natal, Transvaal, and Orange Free State.

Transvaal—Several large deposits of iron ore are known to exist in the Transvaal, and the reserve is considerable, even though the entire country is by no means explored. Beds of titaniferous ore associated



Sketch map of Southern Africa and Madagascar

with the Bushveld granite occur in many places from Waterval north to Klipfontein. They are well defined and will average at least 4 ft. in thickness. Large quantities of ore can be quarried, but much underground mining will also be necessary. The largest deposit is at Magnet Heights, which is estimated to contain over 24,000,000 tons of ore in sight that will average 60.20 per cent iron, 3 per cent silica, 14.30 per cent titanic acid, and 22.30 per cent oxygen. Bands of titaniferous ore are also found in the Magalakwin Valley, and Wagner estimates the total reserve of this type of ore in the Transvaal to be about 2,000,000,000 tons.

In the neighborhood of Pretoria large beds of oölitic ore occur in the shales of the Pretoria series which extend for hundreds of miles in beds varying up to 15 ft. in thickness. The ore is inclined to be siliceous, although it can be cheaply mined. Wagner estimates that the reserve in Pretoria alone that can be taken out by quarrying is 400,000,000 tons of ore that will run 44 to 54 per cent iron, 14 to 35 per cent silica, 2 to 10 per cent alumina, and low in sulphur and phosphorus. This same bed extends to Potchefstroom, Airlie, and Prieska. The reserve of these districts can be put at 600,000,000 tons of ore averaging 48 per cent iron, 18 per cent silica, 0.20 per cent phosphorus, and 0.015 per cent sulphur.

At Buffelshoek, on the Crocodile River, large deposits of hematite ore are known which range from 64 to 68 per cent in iron and are low in silica and phosphorus. At present these deposits are not worked, because of their distance from the railroad, but it will not be long before Buffelshoek will be linked up with the existing railroad system, which is only 75 miles away. Much of this ore can be taken out by open quarrying, and it is estimated that there is at least 50,000,000 tons.

At Buckwood there is a deposit of hematite ore which carries 55 to 65 per cent iron and 5 to 19 per cent silica. It is estimated to contain about 5,000,000 tons of ore. The Krondraai deposits near by are estimated to contain 5,000,000 tons of hematite ore that will average over 60 per cent in iron and low in phosphorus and sulphur.

Hematite deposits of the coal measures occur in East Transvaal at Pullenshoop and Boschmanskop, which are estimated to contain about 10,000,000 tons of available ore. The ore at Pullenshoop contains about 57.30 per cent iron and 11.45 per cent silica; that at Boschmanskop averages 62.40 per cent iron and 2.25 per cent silica.

Cape Province—The only deposits of workable iron ore in Cape Province are in the Klipfontein hills and the

Gamazara ridge, but no prospecting has been done. The reserve is not known, although thought to be large. The ore varies from 38 to 67 per cent in metallic iron content.

Natal—The iron-ore deposits of Natal occur in the rocks of the Swaziland, Karroo, and Recent age, but the known reserve is very small, as there has been practically no development.

Bands of hematite are found in the Swaziland rocks in four belts near Dipka, which carry 36 to 42 per cent iron and about 29 per cent silica. Several beds of iron ore occur below the coal seams in the Karroo rocks near Doornberg and Dundee, which consist of limonite, magnetite, and hematite ores. These ores carry 45 to 55 per cent of iron and are usually high in phosphorus.

Surface deposits of limonite and hematite occur on the Waterberg sandstone plateau in beds which show an average thickness of about 4 ft. Doctor Hatch estimates that there is 135,000 tons of ore in sight on this plateau. Beds of limonite are also found on the slopes of Hathorn's Hill and in the Maritzburg district which carry from 35 to 62 per cent of metallic iron. It is estimated that at least 1,000,000 tons of ore is here that can be mined cheaply.

In common with the other countries in Africa, much of the Union of South Africa is still unexplored. The reserve of the actual available ore is estimated at about 1,100,000,000 tons and the possible ore can be put at over 2,000,000,000 tons.

Table VII—Analyses of the Iron Ores in the Union of South Africa (in Percentages)

District	Deposit	Iron	SiO_2	P	S	TiO_2
Transvaal	Magnet Heights	60.20	3.00	0.10	.....	14.30
	Pretoria	47.85	24.10	0.15	Nil	Nil
	Airlie	31.40	49.00	....	Nil	Nil
	Buffelshoek	66.23	3.35	0.03	Nil	Nil
	Krondraai	64.08	7.40	0.02	0.03	.....
	Boschmanskop	62.40	2.25	0.02	Nil	Nil
Natal	Dipka	41.20	28.92	0.02	0.012	Nil
	Doornberg	65.14	0.67	0.13	.....	Nil
	Dundee	57.90	6.34	0.20	.....	Nil
	Hathorn's Hill	35.00	30.50	0.14	.....	Nil

Several small blast furnaces are situated in the Transvaal, at Vereeniging and Pretoria, and at Newcastle, in Natal, but their production of pig iron is only about 1,000 tons annually. The production of iron ore in the Union of South Africa has been sufficient to take care of this local iron manufacture.

Rhodesia

Directly north of the Union of South Africa lies Rhodesia. It contains a number of deposits of iron ore associated with basic igneous rocks. At present the only ores known to exist that have ore in commercial quantities and of good quality are in Southern Rhodesia. The deposits in Northern Rhodesia are known to be extensive, although not thoroughly explored.

Limonite and hematite ores occur near Victoria Falls, in Southern Rhodesia, which were formerly worked by natives. These ores vary from 25 to 50 per cent in iron and are usually high in silica. Red hematite ore is found near Iron Mine Hill and Que Que which contains from 60 to 65 per cent iron, and magnetites occur in the Sabi Valley and in the Unvukwe Hills which carry about 68 per cent iron. These orebodies are reported to be large, but no details of the reserves are available.

In Northern Rhodesia near Lake Bangweolo lateritic ores cover an enormous area, but the area carries only about 25 per cent of metallic iron. These beds are about 3 ft. thick, and F. P. Mennell states that there is a possible 6,000,000,000 tons of ore in this district. Mennell stated before the Eleventh Geological Congress that "Any estimate of the iron-ore reserves of the world should take into account the enormous development of iron-bearing rocks in Rhodesia, which is probably unequaled in any part of the world that has been exploited up to the present time."

Practically no pig iron has been produced in Rhodesia, and little iron ore is mined. The country is undeveloped in regard to its iron-ore resources, and little information is available. They are thought to be large.

Other Countries of Africa

Bodies of iron ore are reported from Abyssinia, French Congo, Liberia, Egypt, Sudan, Swaziland, and the Portuguese possessions, but little information is available with respect to them and data are lacking as to the quantity or quality.

African Reserves

Little information is available on which to base calculations in estimating the reserve of iron ore in Africa. The reserves given in Table VIII are probably conservative, and will probably be increased on further exploration, as vast areas in Africa have not been prospected.

Table VIII—Iron-Ore Reserves of Africa

Country	Controlled By	Actual Reserve	Possible Reserve
Algeria	France	100,000,000	Large
Tunisia	France	100,000,000	.....
Morocco	Spain	50,000,000	Large
Togoland	France	20,000,000	.....
British West Africa	England	3,000,000	2,000,000,000
Madagascar	France	7,500,000	.....
Union of South Africa	England	1,100,000,000	2,000,000,000
Rhodesia	England	.....	6,000,000,000
Totals		1,380,500,000	10,000,000,000

Over 80 per cent of the total known iron-ore reserves of Africa is controlled by England and the balance by France and Spain. This is indicated in Table IX.

Table IX—Control of Africa's Iron-Ore Reserves

Country	Actual Reserve	Possible Reserve
England	1,103,000,000	10,000,000,000
France	227,500,000	.....
Spain	50,000,000	.....
Totals	1,380,500,000	10,000,000,00

References

"Algeria an Important Iron Ore Source." *Iron Age.* April 8, 1926.

"Minas del Rif and Moroccan Iron," by C. De Kalb. *Mining & Metallurgy.* November, 1916.

"Morocco and Iron Control." *New York Commercial.* Sept. 24, 1926.

"Iron Ores—British Africa," Part 2. Imperial Mineral Resources Bureau. 1922.

"Iron Ores—Europe and Africa," Part 6. Imperial Mineral Resources Bureau. 1922.

"Iron Ores," by E. C. Eckel. 1914.

A Sparkling Jubilee

That a "diamond jubilee" is in order this year for South Africa seems to be the conviction of the *Manchester Guardian.* This publication points out that the first of the South African diamonds was found and used for a plaything in 1867 by the children of a Boer named Jacobs, who owned a farm near the Orange River. It passed through various vicissitudes, fell into the hands of an Irishman named O'Reilly, and was finally identified in the same year by Dr. Atherstone, an English scientist, who happened to be staying at Grahamstown, Cape Colony. Twelve years ago a movement was on foot among the few survivors of the old Kimberley diggers to celebrate the "jubilee" of what has developed into an important South African industry, but in 1917 peace had not returned. It is not probable that many of these patriarchs are still alive.

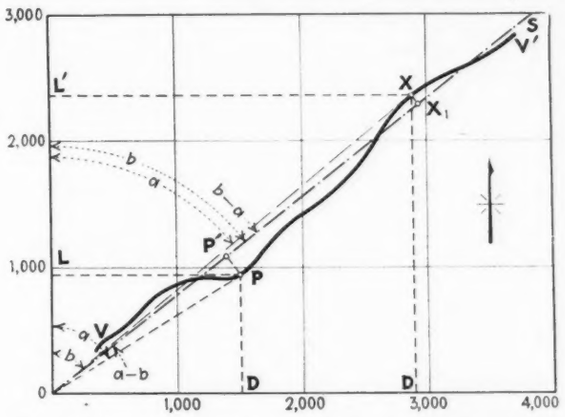
Useful Operating Ideas

Calculation of Longitudinal Co-ordinates

By J. C. Pratt

The following method is for use in plotting survey points and other data pertaining to raises, crosscuts, and workings on longitudinal sections:

In the accompanying figure, VV' is assumed to be the horizontal trace of a vein, and OS is its general strike,



Curve for calculating longitudinal co-ordinates

which is fixed in both direction and position, and to which all points are projected. The line OS, which is the trace of a plane, either vertical or horizontal, passes through the origin of the horizontal co-ordinates in the figure. This need not be the case, however, as will be shown later.

Consider any point such as P, which is to be projected to the line OS at the point P'. It is required to find the distance OP', which is the longitudinal co-ordinate of P. The method and formulas are as follows: Draw the line PP' perpendicular to OS; draw a line from P to O. Let b equal the bearing of the strike line OS; let l equal OL equal the latitude of P; let d equal OD equal departure of P.

In the triangle POP', $\cos(a-b) = \frac{OP'}{OP}$; or, OP' equals $OP\cos(a-b)$. Resolving the cosine of the difference of two angles, the following is obtained:

$$\cos(a-b) = \cos a \cos b + \sin a \sin b$$

As $\cos a = \frac{OL}{OP} = \frac{l}{OP}$ and, $\sin a = \frac{OD}{OP} = \frac{d}{OP}$, it follows by substituting these values, that

$$OP' = OP\left(\frac{l}{OP}\cos b + \frac{d}{OP}\sin b\right) = l\cos b + d\sin b$$

which is the required formula. In other words, the longitudinal co-ordinate of a point is given as the latitude of the point multiplied by the cosine of the bearing angle of the strike, plus the departure multiplied by the sine of the same angle. The same may be proved for a point such as X lying on the other side of the strike line, in which case the angle used is $(b-a)$, which will give the same formula.

It is not necessary, nor often the case, that the origin of the horizontal co-ordinates be the same as that of the longitudinal ones; rather the latter will begin at a point having plus co-ordinates of greater or less size. If such is the case, it is only necessary to subtract the co-ordinates of the longitudinal origin from the total co-ordinates of the point. As an example, let the origin of the longitudinal co-ordinates be lat. 5,000, dep. 8,000, and assume a point with lat. 7849.62, and dep. 9763.45. Subtracting one from the other, we obtain, lat. 2849.62, and dep. 1763.45, which are l and d respectively in the foregoing formula.

Reducing Boulders in Hard-Rock Stopes

As a result of investigations made by the U. S. Bureau of Mines, E. D. Gardner and S. P. Howell reach the following conclusions as to practical methods for increasing the proportions of fines and diminishing proportion of boulders resulting from blasting in hard-ore stopes:

Crushing rock by means of explosive is usually more economical than breaking it by hand. Therefore, if boulders are being formed, more explosive should be used in the drill holes, where the extra amount does useful work. In other words, if the walls and back of the stope will withstand the extra jar, an additional cartridge or two in a hole may often be used to advantage.

The results obtained by experiments indicate that the use of stemming helps decidedly to prevent formation of boulders, does not increase the cost of blasting perceptibly, and lessens appreciably the amount of work needed to break up boulders. The tests show that one stick of stemming to a hole is not enough and that at least two sticks should be used.

The use of high-grade gelatin dynamites makes a substantial reduction both in the size and proportion of boulders formed, and also increases the fines in hard-ore stopes. In addition to their greater shattering power, the higher-grade explosives have more propulsive energy per pound, and probably that fact also contributes to the improved results. Even with the present difference in price, the tests show that the higher grades of explosive are more economical to use.

According to pendulum friction tests, the 80 per cent gelatin should offer no greater risk in loading than the 35 or 50 per cent strength. However, since all explosives, because of their nature, may be made to explode by a variety of causes, the gelatin dynamites should be handled with care and caution.

The analyses of the gases from the explosives indicate that a relatively large amount of carbon monoxide is made by the 80 per cent gelatin, and its use would seem desirable only where the ventilation is good.

Two charges, separated by stemming, in a long hole having an equal burden for the full length make fewer boulders than a single charge at the bottom of the hole. Other factors, however, may make this system of blasting uneconomical.

The condition of the back and face was noted after each test round. The amount of trimming and barring

down varied greatly, but apparently a slight advantage resulted from the use of the 80 per cent strength gelatin instead of that of 40 or 35 per cent. In the opinion of the miners in the stopes where the tests were made at the Calumet & Arizona mine, the rock broke from the back cleaner with the higher explosive, and less trimming was needed.

Avoiding Wear on Elevator Parts

A gravel concern at Wraysbury, England, has a gravel-pumping plant which delivers the material into an elaborate screening plant, according to Reginald Pawle in the *Bulletin* of the Institution of Mining and Metallurgy. The sharp sand of the Thames formerly wore out the elevator rollers and chain rapidly. By adopting the device shown in Figs. 1 and 2 the company has prolonged the life of the elevator chain by

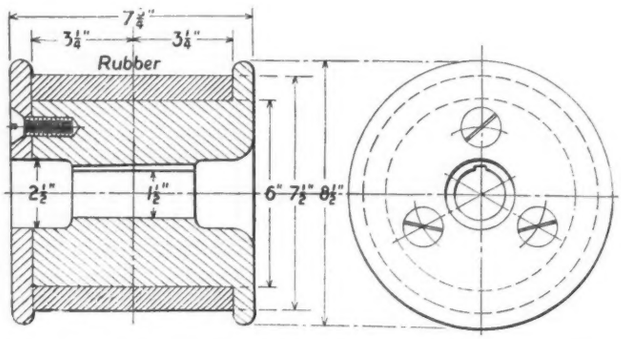


Fig. 1—Cast-iron roller of elevator with rubber sleeve

a period of at least eight months and that of the rollers indefinitely.

Fig. 1 shows the original arrangement, which consisted of a sleeve of rubber on the cast-iron roller. The wear caused by the chain was, however, confined to a given area and, to avoid a waste of rubber, the sleeves were done away with and a number of rubber rings

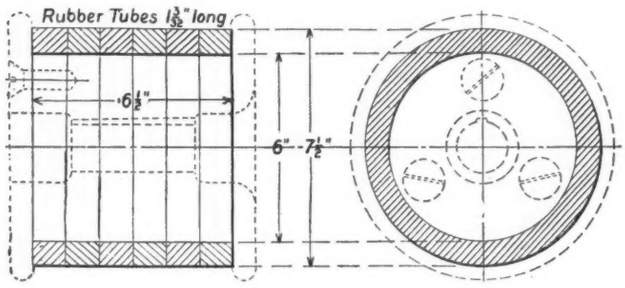


Fig. 2—Rubber sleeve in six separate sections

substituted, as shown in Fig. 2. As the rings wear out, they are replaced. The whole thing is a simple but money-saving device.

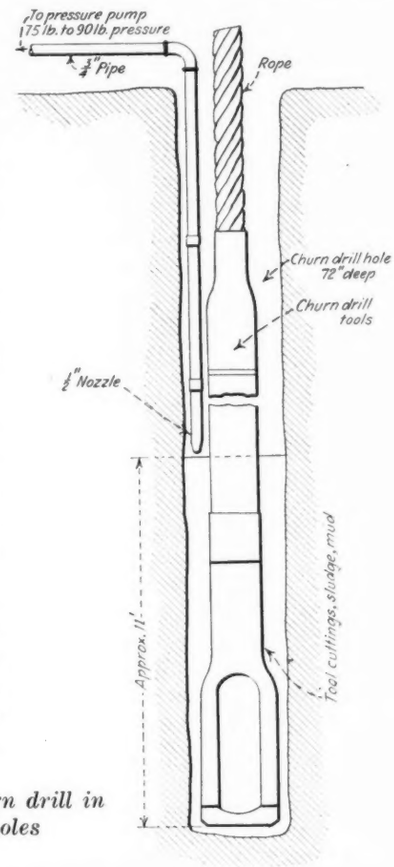
It was also found that the wet sharp sand rapidly cut out the steel chutes in the screening plant. This trouble was arrested by lining them with old rubber tires, which stand up for a long period and cost practically nothing to replace.

The company is also experimenting with rubber sleeves for the joints of the pipe line, which frequently has to be shifted; this means putting in many bends. It is thought that these sleeves will save the bends and allow the pipes to be taken in any direction required merely by springing them.

Releasing "Sanded" Churn Drill

By Roy H. Poston

In the Southeast Missouri lead district, an accident to a churn drill resulted in the string of tools becoming stuck or "sanded" in some 11 ft. of sludge and cuttings. After effecting repairs to the drill efforts made to lift the tools proved futile and recourse was had to a near-by water supply. A string of ¾-in. pipe to which was attached a short nozzle section of ½-in. opening was lowered into the hole. The upper end was attached to a pressure pump and water under 75 to 90 lb. pressure was forced through the pipe. The accompanying figure shows the details. About forty minutes' work with the application of the jet served to loosen the sludge and free the string of tools.



Releasing churn drill in sanded holes

Lead Determination on Ores Containing Barium

By B. W. Deason
Salt Lake City, Utah

After titrating a lead solution with ammonium molybdate, put it back on the hot plate and boil for five minutes. If the ore contains barium it will require more molybdate to give an end point. If the ore contains much barium each repeated boiling will take more molybdate, sometimes raising the assay 5 or 6 per cent, but never raising it high enough to give a correct assay.

After much experimenting I devised the following method for ores containing barium, and it has been in use in the laboratory of Black & Deason for three years, having been also adopted as the regular method on this class of ore by most of the smelters and shippers in the vicinity of Salt Lake City.

Run the assay as usual until the lead sulphate is ready to be dissolved with ammonium acetate. Instead of adding ammonium acetate, add 5c.c. sodium hydroxide solution (1 lb. NaOH to 1,000 c.c. water) diluted to about 25 cc. with water. Boil and then dilute to the usual bulk for titrating. Make the solution acid with acetic acid, not more than 1 cc. excess, using phenolphthalein indicator. Boil and titrate with ammonium molybdate, using tannic acid indicator. The sodium hydroxide must be added alone. When added in addition to ammonium acetate it has no effect.

Discussion

The Myth of El Dorado

THE EDITOR:

Sir—As no one has a more open mind for the last word of fact than my former distinguished editorial colleague, Mr. T. A. Rickard, I venture to add further details to his most interesting story of El Dorado, "The Gilded Man," which was printed in your issue of April 23.

The legend lingered longer than 1775. Considerable areas in South Ameria remained unexplored for more than a century later. The region south of the Tumac-Humac Mountains, dividing Brazilian Guiana from the triple Guianas on the north, was completely out of communication, and had never been penetrated, even by the most greedy rubber gatherer, despite the high price prevailing for "Pará Fina" and "Sernambi" in the great port on the estuary of the Tocantins, which is commonly confused with the mouth of the Amazon. Naturally the legend of the Lake of Parima, with its island of Manoa, where lived the Gilded Man, shrunk into this area, with competition in the imaginative tales of the epoch by two other unknown areas, the valley of the Japurá, an unexplored tributary of the Amazon draining the southeastern portion of Colombia, and the valley of the Pilcomayo, traversing the Gran Chaco, in the northeastern part of the Argentine, close to Bolivia. For some reason, despite the persistence of the story of the custom of sacrificial offerings by the tribe of Guatavitá on the highlands near Bogotá, which would seem to have fully accounted for the ceremonial offering of gold to the waters of the lake, the cartographers of the time frankly placed the fabled lake of Parima in the Guianas, south of the Tumac-Humac Mountains. Serious school geographies, in this country and abroad, showed this lake certainly as late as 1840. Its precise position, comparison of the maps discloses, was unstable. It was given to habits of growth and subsidence, and was fickle in the matter of latitude and longitude, keeping merely within the terra incognita that was sure to be free from the embarrassment of conflicting travelers' tales.

Finally, in 1877, a French physician, of high reputation in France, Dr. Jules Crevaux, whose interest had been awakened by the persistent rumors, current in French Guiana, of the lake of Parima, and its island city of Manoa, just across the Tumac-Humac range, determined to settle the point by a well-equipped expedition into that unknown territory. It was reputed to be inhabited by a dangerous tribe of Indians called the Roucouyennes, which probably signifies the "parrot Indians," from the custom of using macaw and parrot wings and tails in ceremonial decoration, which, however, is by no means restricted to this tribe. Dr. Crevaux found, as has happened so commonly when men of intelligence and culture have penetrated the haunts of the savage, that the Roucouyennes were a peaceable race, and ready to welcome prudent visitors who displayed no tendency to exploit them and their labor.

Of special interest to the mining world, that ever has been fascinated by the legend of El Dorado in our age, just as its equivalent legend of Jason's Golden Fleece excited the minds of mining adventurers in the dawn of Grecian history, Dr. Crevaux discovered that the ceremonial "gilding" of the great chieftain of the tribe, who afterward descended into the waters as an offering, was practiced here as it is said to have been on the Colombian plateau. The details develop into a veritable religious rite.

The city, or village, of the Roucouyennes is built on a long, low area, which yet stands at a higher level than the surrounding land, for the area is what we would term a swamp, subject to annual inundation, similar to so large a portion of the Amazon valley. The chieftain was anointed with clay-slime, and dried mica scales were then blown over him, adhering to the wet clay, and transforming him into a resplendent object, glistening as if "dorado," or gilded. To the sound of pandean pipes, indigenous throughout the Amazonian wilderness, and the tum-tum of drums, dancing at the head of the multitude, the chieftain descended into the rising waters that threatened the safety of the town. It was, therefore, a true propitiatory offering, suggesting that, if angry, the god would not accept the tendered sacrifice, while, if appeased, he would merely wash off the spangled adornment and retire, delivering the people.

Thus Crevaux finally erased the lake of Parima and its golden city of Manoa from the maps, giving the story to the world under the simple title, "Voyage en Guyane en 1877," a voluminous treatise of great scientific value, not only for the anthropological data contained but for the general notes on mineralogy and natural history. Unfortunately it is not available in English translation. After the completion of this work, he returned to South America and explored the valley of the Japurá, which proved a more formidable task than the region of the Roucouyennes because of the previous contacts which the natives had had with the whites. His account is the standard source of information regarding this great river, which flows over 2,000 miles from the Colombian Andes, and winds for about 800 miles through the annually inundated areas of the lower reaches in Brazil. Not content with this achievement, Crevaux essayed the perilous exploration of the Gran Chaco. Tantalized by frequent attempts that had been made to draw the secrets of the Pilcomayo, the Indians proved distinctly hostile. He also is reported by survivors of the expedition to have committed a great indiscretion in dealing with savages, by giving them cloths, needles, mirrors, and other objects supposedly dear to the hearts of the indigenes, as a free, perhaps as a propitiatory, offering. They fell upon him in order to get all his trinkets at once, and slew him. Even in the education of the primitive Indian it is necessary to inculcate the fundamentals of ethics, without which an understanding of property rights cannot be grasped, and that involves refraining from giving something for nothing.

COURTENAY DE KALB.

New York City.

News of the Week

Summary

BY AN AGREEMENT signed on May 5 by the U. S. Bureau of Mines, the Tri-State Zinc and Lead Ore Producers' Association and the Metropolitan Life Insurance Company, the U. S. Bureau of Mines clinic at Picher, Oklahoma, will receive $40,000 annually to carry on and expand the work it is doing in the Joplin-Miami district.

The Ontario Bureau of Mines report of gold production for the first quarter of 1927 shows a total recovery value of $7,701,762, which is an increase of $100,000 compared with the corresponding period of the previous year.

According to a report from reliable sources the Phelps Dodge Corporation has purchased the Humboldt concentrator from the Southwest Metals Company.

An extensive sodium-nitrate deposit is discovered near Candelaria, Tex.

The Tasmanian Government proposes to introduce legislation which would grant a sustenance allowance of £8 per month to prospectors and to each man employed by companies or syndicates on approved prospecting work. Advances of £500 or more would be made to companies engaged on work recommended by the government technical offices, but these advances would be on a pound for pound (sterling) basis. The legislation also provides for drilling at cost price by government agencies for companies or syndicates.

The second gold strike within a week occurs in the Yuma district of Arizona, this time at the Tritt mine, near Laguna dam. The largest gold rush in the district in two decades is reported to be on.

The 1926 consolidated payroll for the Transvaal gold mines amounts to £14,257,244. Of this amount £7,735,-087 went to Europeans and £6,522,157 to natives.

The Recent Collapse of Mount Isa Shares

London Letter of April 26 Reviews Situation—Option Abandoned by Anglo-American Corporation—Panama Corporation's Finance Discussed

By W. A. Doman
Special London Correspondent

THE MOUNT ISA sensation, to which attention was called last week, continued later, and was even greater when it became known that the Anglo-American Corporation, on the advice of Carl Davis, its technical director, had abandoned its option over the 500,000 shares which it had obtained. The shares fell at one time to 1⅛d. and were said to be almost unsalable, but they recovered to over 20s. Although the official announcement was not made known until Thursday last, the decision had evidently leaked out owing to the heavy drop in the quotation to which I referred. Who sent the hint to sell cannot be ascertained. One engineer who is well acquainted with Australia suggested that it was due to the use of the Morse code, and that someone who heard this being sent got the "hang" of it and cabled orders to sell. The last has not been heard of the property, as it is stated in well-informed quarters that four separate parties have put in a similar proposition. Chester Beatty is said to be at the head of one of the groups. Apparently, the idea of the newer applicants—and Australian Broken Hill financiers are among them—is that the sulphide ores can be made to pay, and that while they are being worked science will come to the aid of the carbonate ores, and so give that margin of profit which the Anglo-American engineers could not foresee. The property is scarcely likely to be turned down altogether, as it seems to be a vast deposit, and should be capable of profitable working. Many persons who followed the Anglo-American Corporation, knowing that it is always out for big profits, have burnt their fingers. It is realized—now that it is too late—that over 40s. a share for a property that is in doubt is a high figure and one purely speculative.

Last week D. Elliott Alves, the promoter of the Panama Corporation, on his return from a visit to the property, was the guest at a banquet at the Carlton Hotel given by about fifty of his supporters. He referred to high assays that had been obtained in working the areas and spoke optimistically of the future of the undertaking. He referred, also, in rather severe terms to the criticisms passed upon the prospectus, which in his view were unwarranted. These criticisms, however, were not so much on the property itself as on the finance connected with the promotion. The intention was to float the undertaking with a huge capital; as the property was not developed to any extent it should have been tested first by a small syndicate, leaving the greater flotations to come later when there was something substantial to base conclusions upon. Even now, although high assays have been obtained, technical men are of the opinion that it is too early to talk of success.

Just at the moment the market is agitated at the price of platinum. South African financiers who had expected great things from the deposits in the Lydenburg district have received a shock. Professor Kovaloff, the Russian platinum expert, who has investigated the Transvaal occurrences, has stated that the only hope of saving the industry in the Transvaal is the erection of a local refinery. He says that Russia is installing dredges in the Urals, and will be able to supply the world's requirements next year. She could, he said, profitably produce from one grain per ton of ore. The price of the metal has dropped from £25 per ounce to about £19 10s.

Another Gold Strike in Yuma County, Ariz.

Yuma, Ariz., is experiencing its second gold strike excitement within a week, as the result of news that leaked out regarding a rich discovery at the Tritt mine, two miles from Laguna dam, on the Colorado River, and about 17 miles from Yuma, according to accounts just received.

Rich ore samples are reported to have been brought in, which included heavy deposits of gold flake and small nuggets picked up at random. It is said the vein can be traced in outcroppings for a distance of 700 ft. The property is owned by a group of Los Angeles business men. A shaft has been put down 73 ft., and the gold is reported throughout the ledge.

News of the Laguna strike, which is in the old proven pot holes of the California mining district, follows by just a week the discovery of a rich field in the Kofa district.

Joplin-Miami District to Have New Clinic Building

Tri-State Zinc Buys White Lease—Peru Tailing Mill Sold to Golden Rod Co.

Several cases of trachoma, a serious and infectious disease of the eye, have been discovered in the Joplin-Miami district by Dr. F. V. Meriweather, head of the U. S. Bureau of Mines clinic, located at Picher, Okla. An effort will be made to prevent further spread of the disease. Two of the cases discovered have been sent to a government hospital for treatment, and all miners in the field who have sore eyes are being urged to get an examination at the clinic.

A contract for a new clinic, to be located on the site of the one already established in Picher, has just been let. Companies employing approximately 7,000 men have signed a contract to support the new clinic, which is being sponsored by the Bureau of Mines, the Metropolitan Life Insurance Co., and the mine operators of the district. Four doctors will be stationed at the clinic, when it is finished, and every miner in the district will be given a free examination. Mine operators have agreed to employ only men who have had such an examination and who consent to periodic examinations after going to work.

The lease and concentrator of the White Mining Co., located in the Oklahoma section of the Joplin-Miami district, was sold about the first of May to the Tri-State Zinc Co., Inc., for approximately $200,000. The Tri-State company is a subsidiary of Consolidated Gold Fields, of South Africa, which is represented in the Joplin-Miami field by A. J. Klamt. This is the first operating mine the concern has acquired, although it had previously taken up considerable acreage. The White mill is a 200-ton concentrator with gas equipment for power. It was owned largely by Otis White, of Joplin, with L. Cartright, of Joplin, and W. H. Trapp and John Weaver, of Miami, as minority stockholders.

H. T. Moss and associates, of Kansas City, have taken over the lease of the Dallas Mining Co. on 240 acres of zinc- and lead-mining land near Aroma, Mo., in the Granby field, and are beginning an extensive development campaign preparatory to starting up the mill. The Dallas shaft was sunk to the 258 level, though drill records show this to be virtually the top of the semi-sheet ground ore deposit, which extends down to 280 ft. It is planned to sink the shaft to the deeper depth in the near future.

Commerce Mining & Royalty Co. has completed its new all-steel mill on the Blue Goose tract near Cardin, in the Joplin-Miami district. It is the second all-steel mill in the district. It is not expected that the mill will be put into production immediately, however, on account of the low price of zinc ore.

The Golden Rod Mining & Smelting Co. has purchased the tailing mill located on the lease of the Peru Mining Co., southwest of Baxter Springs, Kan., in the Joplin-Miami district, and has also practically completed its new mill on the Weiss lease, south of Hockerville, in Oklahoma.

Manganese Producers Form Committee

IMMEDIATELY following the adjournment of the meeting of the American Institute of Mining and Metallurgical Engineers in Cleveland, Ohio, on April 20, a voluntary committee of American producers of manganese ore was formed for the purpose of protecting and advancing the interests of domestic producers. The committee is as follows:

J. Carson Adkerson, Woodstock, Va.
N. H. Mannakee, Bluefield, W. Va.
H. A. Pompelly, Owego, N. Y.
J. H. Cole, Phillipsburg, Mont.
William D. Meyering, City Hall, Chicago, Ill.

All persons interested in American manganese ores are advised to communicate promptly with one of the above-named committee so that they may receive information and be notified of a convention to be called at an early date to advance the interests of producers of manganese ores in America.

Steady Progress Reported in the Belmont District

A good flow of water is said to have been encountered in the new well recently sunk by the Tonopah Belmont Development Co. on its McNeil property, about seventy miles northwest of Phoenix, Ariz. This well is approximately four miles from the old well; the volume is said to be sufficient to supply the mill and camp. Water was struck at 340 ft., but the well was deepened to 640 ft., materially increasing the volume of flow.

Substantial values in lead, gold, and silver are reported to have been found in a vein in the South Belmont crosscut at a depth of approximately 200 ft. The vein has been exposed for a width of 12 ft.

The new discovery is at a point on the contact zone and about a mile from the Belmont shaft. Practically all the other properties in the district are working steadily, and are reporting satisfactory results.

M. A. Hanna & Co. to Operate Maroco Mine at Trommald

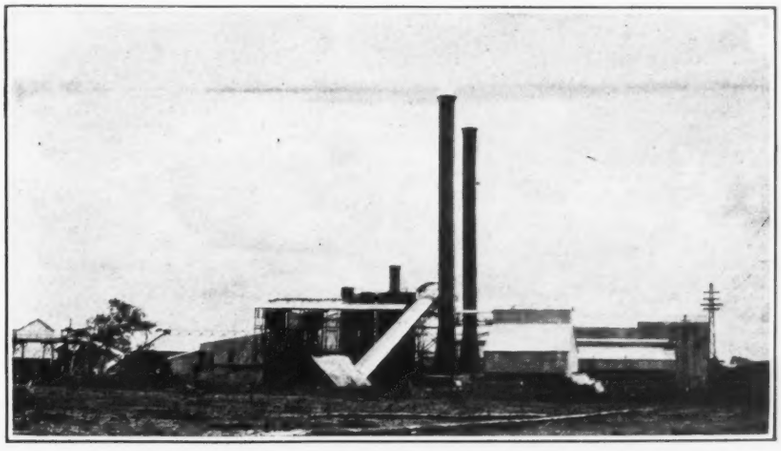
M. A. Hanna & Co. have taken over the operation of the Maroco mine at Trommald, Minn., through a sub-lease from the North Range Iron Co., intermediate lease holders of the property. The Hanna company will start production at once and expects to ship a substantial tonnage from the mine this season. The Maroco was opened up in 1920 by the Marquette Ore Co., which during the last five years has stripped two million yards of overburden and shipped 971,000 tons of ore from the mine. The Marquette Ore Co., which is reported to have lost a million dollars in operation because of high development costs and excessive royalties, surrendered its lease Dec. 31, 1926.

Determination of the ownership of the fixed equipment, including a half-unit ore-washing plant erected at a cost of $100,000, awaits the decision of Judge Kenney of the Duluth district court, before whom a hearing has recently been completed. The North Range Iron Co. claims the fixed equipment under the terms of an ore-exhaustion clause in its lease; the former operators claim there is no ore left in the mine merchantable to them under the terms of the lease.

The Maroco is an open-pit mine producing wash ore and some direct shipping ore. Last season a large proportion of the output was shipped all-rail.

Outlook at Bwana M'Kubwa Promising for 1927

In the course of the annual meeting of the Bwana M'Kubwa Copper Co. recently held in London it is understood that the report of the company indicated that Bwana M'Kubwa, with the N'Kana property, has developed 8,900,000 tons of 4 per cent copper ore. It is planned during the coming year to operate the treatment plant at its full capacity, as it is believed the difficulties experienced in 1926 with the plant have been overcome. Installation of additional plant units is being considered. If the plans in view are followed, the annual plant production should reach 20,000 tons. The producer section of plant is shown in the foreground of the accompanying photograph. The ammonia leaching plant is in the background.



The treatment plant of the Bwana M'Kubwa Copper Co.

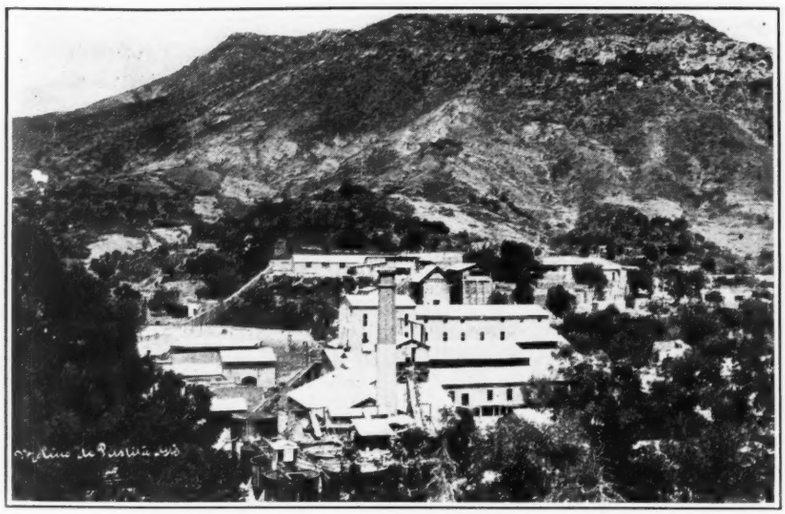
Melbourne Letter

By Peter G. Tait
Special Correspondent

Tasmanian Prospecting May Be Subsidized—Mount Morgan Awaits Barker Report

Melbourne, April 7—The Tasmanian Government is introducing legislation with a view to developing the mineral resources of the state. Its policy is to assist prospectors in their efforts to find new deposits by a sustenance allowance of £8 per month, and to give a similar allowance to each man employed by syndicates on approved development work. Advances of £500 or more may be made to companies engaged on work recommended by the technical offices of the department, but these advances will be made only on a sterling pound for pound basis, and when the necessary security over plant is forthcoming. The department technical staff has been augmented and a diamond drill has been purchased. Drilling will be carried out for companies or syndicates by the department at cost price, and unalienated areas of Crown lands will be systematically bored. To meet the increased expenditure a small tax or royalty on all mineral production is to be imposed. All of this tax will be expended on mining development.

E. E. Barker, the American mining engineer who recently visited Mount Morgan to report on the proposal to work the mine by open-cut methods, is returning to America to confer with his associates before completing his report. In the meantime the company has placed the reverberatory furnace in operation to treat the accumulation of calcines, purchased ore, and other materials on hand. It is hoped to run the furnace continuously for about four months so as to obtain data regarding costs and efficiency. If the report of the American engineers is satisfactory a large expenditure will be called for in the reorganization of mining and treatment methods.

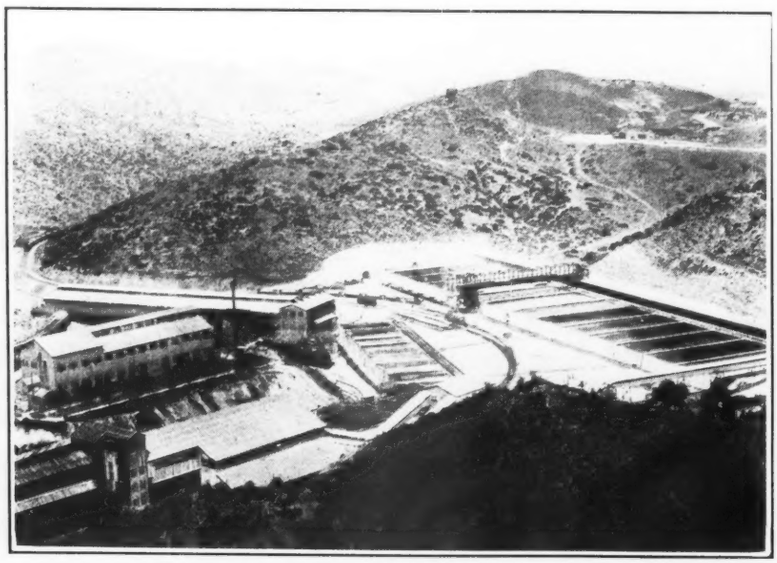


The mill of the Guanajuato Consolidated Mining & Milling Co. at Guanajuato, Mexico

The first unit of the Mackay process is approaching completion at Mount Elliott, and the crushing, roasting, and leaching sections are expected to be given trial runs soon. H. S. Mackay, who is now general manager of the company, confirms earlier reports as to the extensive ore reserves available. He urges that prior attention should be devoted to the development of the porphyries and expresses the opinion that the deposits within 6 miles of the plant can produce by open-cut methods 5,000 tons per day. The pilot unit of the new treatment plant will treat 50 tons per day and, if successful, the plant will be immediately enlarged to treat 500 tons per day.

Carl Davis, mining engineer, who has been inspecting Mount Isa mines on behalf of the Anglo-American Corporation of South Africa, is leaving Australia on his return journey to England this week. It is reported that the company's option, which expires in a few days, has been extended until early in May to enable the reports by the other experts to be completed. Harold Titcomb, Richard Geppert, and Frank L. Bosqui are still at work on the field.

The report of the technical committee appointed to report on the Kalgoorlie mines has not yet been published, although it was in the hands of the Development & Migration Commission three months ago. In the meantime there are rumors of negotiations proceeding for the amalgamation of various properties along the Golden Mile, but the feeling in Kalgoorlie is that amalgamation in itself is not going to increase the output. When it comes to the question of a complete organization of the mines and their equipment, the problem of heavy capital expenditure must be faced, and, if one can judge the position correctly, the London directors of the various companies are not disposed to take the risk of such expenditure being remunerative without definite assurances from the Western Australian or Commonwealth governments.



Plant of the Inspiration Consolidated Copper Co., near Globe,, Ariz.

Labor Conditions Better at Guanajuato

The Guanajuato Consolidated Mining & Milling Co., Guanajuato, Mexico, reports that the development work in progress during the last several months has been satisfactory. Labor conditions also were more favorable than they were last year. The company's mill at Guanajuato, which is shown in the accompanying photograph, uses both concentration and cyanidation. It has a capacity of 325 tons.

Inspiration Consolidated Returns Lower

Lower returns for 1926 as compared with those of 1925 are shown by the annual report of the Inspiration Consolidated Copper Co. This condition is attributed to the mining problems encountered in the Live Oak section of the mine and to the low output of the leaching plant, which was put into operation so late in the year that little could be expected of it so far as returns were concerned. Operations of the company this year have been materially affected by the low price of copper.

Mexico City Letter

By W. L. Vail
Special Correspondent

A Review of the New Mining Tax Laws—Mineral Exports Increase in Value

Mexico City, May 4—The new mining tax law, which went into effect May 1, carries most of the provisions of the old law, but makes concessions in favor of silver and coal and reduces to a minimum fines for slack payment of taxes. It provides for three classes of taxation: 1, A ground tax; 2, a production tax; 3, a tax on physical assets, coinage and the smelter assays.

Regarding land tax, holders of mining titles under the law of Nov. 25, 1909, will pay, each three months in advance, on from one to five pertenencias (claims), 2 pesos per pertenencia; from six to fifty pertenencias, 3 pesos per pertenencia; from fifty to one hundred pertenencias, 4 pesos per pertenencia; one hundred and one pertenencias and more, 6 pesos per pertenencia. The progressive increase on holdings applies only where the claims are under the same ownership or in the same mineral district.

Holders of concessions under the law of May 3, 1926, will pay a general flat tax of 4 pesos and 50c. per hectare (pertenencia), with the exception of coal lands, on which the tax has been reduced to 15c. per hectare. These taxes are enforced whether the property is worked or not.

The tax on silver is based on a sliding scale, with prices fixed in New York. Taxes on other metals remain about the same.

According to a statement given out from the Federal Department of Mines, conditions were much more favorable for January this year than during the same month a year ago. Total production of minerals for the month of January, 1927, is given at 23,908,442 pesos, against 15,449,058 for January, 1926. Exports of metals for January this year are valued at 22,209,051 pesos, against 13,598,766 pesos for January of last year. Gold exports during January this year amounted to 875,659 pesos; silver, 9,800,286; copper, 3,232,841; lead, 5,378,988; zinc, 2,710,478; antimony, 78,828; graphite, 38,860; mercury, 29,303; arsenic, 11,808.

The department believes that a report for the first six months of the fiscal year will show a general increase in production and a considerable improvement in profits.

The Secretary of Commerce and Industry, in charge of mining affairs, reiterates a previous decision that the clauses with reference to obligatory minimum production and obligation to do a minimum amount of work, inserted in the new mining laws, do not apply to those properties already patented before this law went into effect. There appears to have been considerable confusion on these points, and the statement above given is in reply to an inquiry from the Chihuahua Mining Chamber.

By order of the Federal Government, work has been resumed on the automobile road intended to open up the mining regions around Sultepec, State of Mexico, Valle del Bravo and Zacaulpan. The road is intended to be completed within two years, and is supposed to cost approximately 2,000,000 pesos. It opens up one of the richest mineral sections of the country, which has been very much restricted in its operations for several years because of lack of communication.

The annual report of the directors of the Santa Maria de la Paz mine, San Luis Potosi, states that the outlook is more favorable than it was six months ago. New bodies of ore have been encountered carrying better assays, and there are prospects of making a strike in the neighborhood of the Esperanza vein, which produced the last bonanza results for the property. A commission is now making a study for the purpose of installing a new plant that can treat the low-grade ores profitably.

A number of English capitalists are reported to be making an investigation in Aguascalientes and Zacatecas for the purpose of taking over a number of isolated tin properties in those sections. Several small properties in the State of San Luis Potosi are also being considered.

According to a report recently rendered to the Governor of the State of Durango, by the chief state engineer, Miguel de la Parra, it will cost 143,000 pesos to construct a service automobile road from the mining camp of Guanacevi to the railway station at Tepehaunes. The governor proposes to attempt to raise a part of the cost from the sections crossed by the road; the balance will be forthcoming from the state treasury. In anticipation of early starting of work a number of mining denouncements have been recently filed in the sections effected.

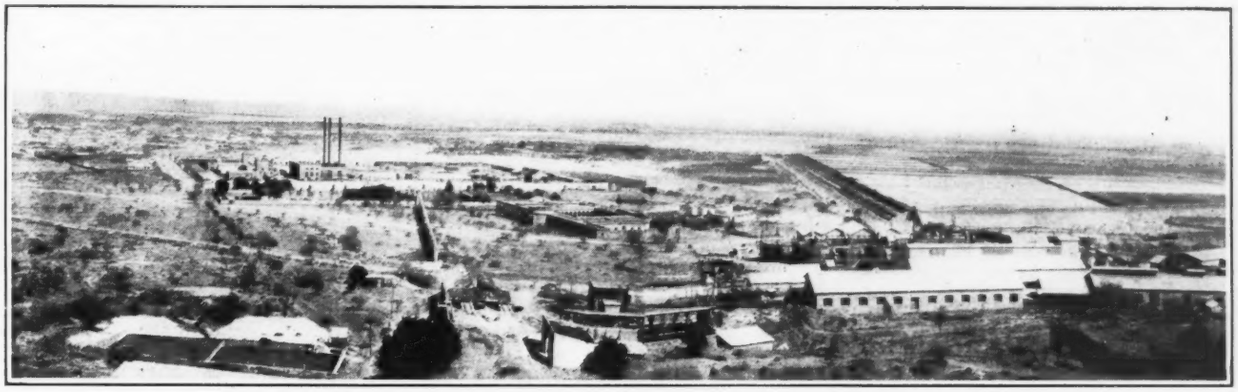
The Cia. Minera y Fundadora de Zimapam, at Zimapam, State of Mexico, reports a satisfactory progress in exploration and development during the past year. With the bettering of roads to connect with the National lines, considerable actual mining may be expected.

It is reported that the Chihuahua Lead Co. has leased from Leon Joannus and associates, the Maria Luisa, Matilde, and Lucia mines, located in the Sierra de las Damas, Aldama district, State of Chihuahua. The lease is for one year and the price mentioned is $200,000.

H. J. Filsinger, for twelve years assistant superintendent at the Real del Monte mines, Pachuca, has assumed the general management of the properties of the Majestic Mining Co., a Kansas City concern at Tapada, district of Totoloapam, State of Oaxaca. Mr. Filsinger is authority for the statement that the new 50-ton reduction plant will be started during May.

The Republican Milling & Mining Co. has obtained permission from government authorities to close the company's plant temporarily because of inability to obtain ores. Much of the surplus rolling stock of the National Railways has been taken over by the military authorities. The plant is at Wadley, State of San Luis Potosi.

At Huizico, between Iguala and the Balsas, a number of small furnaces are going.



A panoramic view of the Fresnillo properties in Zacatecas, Mexico

Fresnillo Properties Mine Sulphide Ores

The annual report of the National Mining Corporation of London states that a profit of £28,000 was made in eight months at the Mexican properties of the corporation. It is also stated that the decline in silver was particularly felt at the Fresnillo properties in Zacatecas. However, in this instance the exploitation of the sulphide ores enabled the property to make a profit. The Fresnillo sulphide ore reserves have been estimated to be 129,419 tons. Oxide and cyaniding ore reserves have been estimated at 5,861,031 tons. A view of the property is shown above.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Ontario Gold Recovery for First Quarter 1927 Valued at $7,701,762

The Ontario Bureau of Mines report of gold production for the first quarter of 1927 shows a total recovery of $7,701,762, an increase of $100,000 compared with the corresponding period of the previous year. The tonnage treated was 1,009,681 tons, compared with 855,516 in 1926. An average grade of $7.70 a ton compares with $8.90 in the 1926 period. The increase in total value is largely accounted for by the Lake Shore, which produced $762,761 in the 1927 quarter, compared with $493,553 in 1926. During the quarter the Porcupine mines treated 848,610 tons and recovered $5,801,908, an average of $6.83 a ton. Kirkland Lake mines treated 161,071 tons and recovered $1,899,854, an average of $11.80 a ton.

Diamond drills at the Alderson-McKay property, in Quebec, have intersected 41 ft. of good ore at a depth of 400 ft. in No. 3 orebody. This is the same orebody which has been developed to the 125 level, but the width at 400 ft. as indicated by the drills is about 10 ft. greater than the average at 125 ft. The former estimate was $4,000,000 of ore, but it is obvious that this will soon have to be revised.

The Supreme Court of Canada recently handed down a decision of interest to the holders of mining lands, which arose out of an action started in 1925. Certain properties in the Township of Bucke, in the Cobalt district, had been sold for taxes in 1920. The property was bought in by J. I. Ritchie, who later disposed of part of it to others. The company which was the original owner sued to recover title, since under Section 40 of the Assessment Act, buildings, plant, and machinery in or under mineral lands were not assessable, and the minerals in or under such lands were not assessable. If this was the case minerals could not be assessed under this section of the act, and therefore the mineral rights could not be sold for taxes. This contention was upheld by the appellate division, which stated that all that could be sold was the surface rights. As this judgment would seriously affect all townships in which mineral lands are situated, the case was carried to the supreme court, which reversed the decision. It was held by the supreme court that the term "lands" includes mines or minerals in or under any such lands, and that Section 40, which the appellate division had quoted in its judgment, was only for the purpose of preventing a double assessment in some cases. It was also shown that Section 5 of the Assessment Act sets out specifically all property which is exempt from taxation.

The Pioneer Mining Corporation reports that diamond drilling on the Jubilee vein adjoining the Copper gold mines, in Michipicoten, showed an excellent grade of ore in the last four holes over a length of 250 ft.

Arizona Mining Properties Report Good Results

Reliable Information Is to the Effect That Southwest Metals' Humboldt Concentrator Has Been Sold to Phelps Dodge

It is reliably reported that the Phelps Dodge Corporation has purchased the Humboldt concentrator from the Southwest Metals Co. The plant will be run as a custom mill and all classes of ore will be bought for concentration and shipment to the Douglas smelter.

Assay reports on samples recently brought to Yuma from the Kofa district, by James McDonald, veteran prospector and "desert rat," are reported to have shown gold values of $60 to $44,000 per ton. The rush to the district, over the Yuma-Polaris highway, is reported to be still continuing, with a persistent stream of automobiles and other vehicles making the 75-mile trek from the railroad to the mines. McDonald made his find of the rich ore vein in the vicinity of the North Star and old King of Arizona mines, both of which have past records closely approximating $1,000,000.

Development work in the Emerald Isle property, lying on the flats between Mineral Park and the Chloride-Kingman railway, in Mohave County, Ariz., is said to be showing up a body of copper ore on the 100 level. Discontinuing drifting, the company has started raises at two points, one at the heading of the 150 ft. crosscut, and the other close to the bottom of the old shaft. The drifts have been carried out 900 ft. in the orebody, which the crosscut shows to be fully 70 ft. wide. The main body of the ore is amenable to leaching. During the war some concentrates were made and shipped. The Emerald Isle adjoins, on the north, the Richard Malik property, formerly held under option by the Calumet & Arizona Mining Co.

According to a statement attributed to Gordon Campbell, president of the Calumet & Arizona Mining Co., made public at a recent meeting of the company, "Verde Central is disclosing good showings but is yet far from being a mine." Mr. Campbell went on to state: "A new mine would mean much to Arizona and Jerome. Work at the Verde Central will be pushed forward, as in the past, with the hope of discovering a good commercial orebody. At present we are finding many small orebodies, but the present price of copper prohibits stoping these to determine their extent."

At the annual stockholders' meeting all present officials were re-elected: Gordon R. Campbell, president; William F. Staunton, vice-president; E. J. Collins, vice-president; James E. Fisher, vice-president and treasurer; A. J. Dunstan, secretary; and Harry E. Paul, auditor.

One unit of United Verde's new flotation plant at Clarkdale, Ariz., has been placed in operation and is treating 450 tons of ore per day. A second unit will be placed in use within a month. The total capacity of the two units when their full efficiency has been reached will be 1,200 tons per day.

Washington Letter

By Paul Wooton

Special Correspondent

Picher, Okla., Clinic Receives $40,000 Annually—Dolomite Displacing Magnesite

An agreement was signed May 5 by the Tri-State Zinc and Lead Ore Producers' Association, the U. S. Bureau of Mines and the Metropolitan Life Insurance Co., whereby $40,000 annually will be furnished for the maintenance of a clinic at Picher, Okla. All new men entering the employ of the mines in the district will be examined at the clinic, and periodic physical examinations will be made of all employees. One-half of the expense will be borne by the operators and one-fourth each by the Bureau of Mines and the Metropolitan company.

By means of the clinic persons with tuberculosis will be detected before they are employed. Any occurrence of the disease among the employees will be detected in time to make a cure possible. Studies also will be made of silicosis.

Efforts have been continuous for many years to reduce the occurrence of silicosis in this camp. The very effective efforts which have been taken to reduce the amount of dust in the mines have greatly improved the situation. The most urgent need at present is to eliminate all tubercular persons, as those with silicosis, in even a mild form, are particularly susceptible to that disease.

Figures reaching the Department of Commerce indicate that dolomite is displacing magnesite, to a considerable extent in the manufacture of refractory lining of basic open-hearth furnaces and of converters and settlers at copper smelters.

Oro Golconda Lets Contract for 2,300-ft. Tunnel

The Oro Golconda Mining Co., a consoldiation of the old Golconda, Middle Golconda, and Oro Plata groups on Stockton Hill, about 20 miles north of Kingman, Ariz., is reported to have let a contract for a 2,300-ft. tunnel to tap the mines at depth. The contract was awarded to A. S. Pierce, who drove the 5-mile Roosevelt tunnel to drain the lower levels of big mines in the Cripple Creek district.

As proposed, the tunnel will serve two purposes—to drain the mines and to provide a working outlet. It will be driven about 40 ft. under the Oro Plata and will tap the Golconda at the 1,000 level. Existence of rich orebodies in the properties is said to have been established.

The Oro Plata was operated until 1913, when it was flooded; Golconda closed down when the mill burned during the war. Both Golconda and Oro Plata have records as heavy producers, but Middle Golconda is of more recent development. The tunnel will start from the lower western slope of Stockton Hill and will traverse many veins of importance before reaching its objective.

Sodium Nitrate Deposit Found Near Candelaria, Tex.

The recent discovery near Candelaria, Tex., of a deposit of sodium nitrate, containing millions of tons of this fertilizer and covering several thousand acres of land, has caused much activity in the matter of filing mineral claims and development operations. A. Snell, of Houston, and associates have acquired title to mineral claims embracing a large area of the sodium nitrate deposits and have completed surveys preliminary to starting work of mining and shipping the fertilizer. The deposits are about 30 miles from the nearest railroad point on the Southern Pacific. Hauling will be done by motor truck either to Valentine or Marfa, it is stated.

The sodium nitrates are found in the most arid part of the upper Rio Grande border region. Chemical tests of the various samples taken from the deposit show that it is of high grade, according to Mr. Snell. He expressed the belief that the new industry will prove of great importance and benefit to agricultural interests of the country.

Montana Operations

George Vaupel and C. W. Buntin, of Lewistown; Julius Coettel and Leonard Johnson, of Hilger; and C. A. Gramley, of Brooks, Mont., have formed the Iron Gulch Mining Co. with a capital of $50,000.

The shaft of the Butte Copper Consolidated Mines is being sunk from the 135th level to the depth of 500 ft. An attempt will be made to reach at that depth the four veins encountered on the 135th level. The property is located at Elk Park, 15 miles from Butte.

Maxville Gold & Silver Mining & Development Co., operating at Maxville, Mont., states that since the company started operations a crosscut tunnel has been driven for a length of 486 ft., and the vein drifted on for a length of 1,500 ft., opening four shoots of ore. Several raises were also driven to connect with the old workings above. A shaft from the tunnel level has been completed to a depth of 100 ft., at which point the vein was opened for a width of 56 ft. exposing 30 ft. of ore.

Burnet Copper Co. to Operate Sheridan Copper Mine

The Burnet Copper Co., which was recently formed and took over the Sheridan copper mine near Burnet, Tex., is constructing a concentrating plant and will operate the mine on a large scale, according to report. The company has more than ten thousand tons of ore blocked out within 80 ft. of the surface.

Comanche Extends Adit

The Comanche mine, near Benton, Calif., according to local reports, has encountered some shipping ore in its Kerrick shaft, which has been rehabilitated and is to be extended from the 850 level to the adit level. The adit has reached a length of 3,130 ft. and is to be extended to the Comanche ledge, about 6,340 ft. from the portal.

Construction Work at Eureka, Utah, Mines Progresses

Excellent progress is being made near Eureka, Utah, in putting the North Lily mine of the International Smelting Co., adjoining the Tintic Standard, in condition for large-scale production and exploration. The headframe for the three-compartment shaft to be sunk to serve the North Lily, the Eureka Lily, of the Chief Consolidated Mining Co., and other mines has been erected. A three-mile road has been built to Eureka, where the working crew will live. The North Lily company will not maintain living quarters at the mine. A bus line will be run from Eureka to the North Lily to furnish transportation for employees. Hoisting and other equipment is to be installed and an office building erected.

During eight days, the Tintic Standard crew, using a Butler mechanical shovel to drive the drift on the 900 level of the No. 2 shaft into North Lily ground, made 221 ft. of progress. By June 15, the North Lily 900 drift should reach a point 200 ft. below the large orebody opened up on the 700 level.

Production of the North Lily mine has been averaging about 400 tons weekly. In the adjoining Eureka Lily, a promising stope is being opened up in the west drift from the 700.

Diamond-drilling operations in the Central Standard mine north of the North Lily have been suspended by the United States Smelting, Refining & Mining Co.

Placer Mining to Be Resumed in Yavapai County, Ariz.

For the first time in years, placer mining on a large scale is to be prosecuted in Yavapai County, Ariz., once the scene of active operations. Announcement has been made that the Lynx Creek Mining Co. has started water running over 216 ft. of sluice boxes, set up in Lynx Creek, ten miles from Prescott. A steam shovel has been installed, and a dam to impound water for the sluicing has been completed. The company is reported to have secured leases along eight miles of the creek and expects to operate the placer bed for a number of years. A permanent camp has been built.

State Geologists Confer With Federal Survey Officials

The Association of State Geologists, on invitation of George Otis Smith, Director of the U. S. Geological Survey, met in Washington, D. C., on April 25 and 26 for a conference with officials of the federal survey. Sixteen state geological surveys were represented. Those present were: H. A. Buehler, of Missouri; G. C. Branner, Arkansas; J. A. Bownocker, Ohio; E. F. Bean, Wisconsin; C. N. Gould, Oklahoma; Herman Gunter, Florida; C. A. Hartnagel, New York; M. M. Leighton, Illinois; H. B. Kummel, New Jersey; E. B. Mathews, Maryland; S. W. McCallie, Georgia; R. C. Moore, Kansas; Wilbur A. Nelson, Virginia; W. F. Pond, Tennessee; R. W. Stone, Pennsylvania; and I. C. White, West Virginia.

Johannesburg Letter

By John Watson
Special Correspondent

Transvaal Gold Mines' Payrolls Totaled £14,257,244 for 1926

Johannesburg, April 5.—Production of minerals in the Union for February aggregated a value of £4,902,501. This figure is £268,312 below the January total. Compared with February of 1926 this year's aggregate for February shows an improved value of £585,520. The detailed figures follow:

	1927		1926
	February	January	February
Gold	£3,305,286	£3,578,872	£3,202,618
Silver	9,611	9,865	10,255
Osmiridium	4,547	7,163	3,489
Platinum	14,360	16,723	.....
Diamonds	1,185,502	1,112,632	687,854
Coal	290,668	294,883	307,478
Copper	27,968	85,173	42,869
Tin	24,873	37,924	40,437
Other minerals	39,696	27,578	21,981

During 1926 the Transvaal gold mining industry expended the total of £28,201,445 on stores and wages, which is an increase over the 1925 figures of £638,145. Stores consumed aggregated in value £13,944,201; salaries and wages to white employees amounted to £7,735,087 and for natives and colored workers £6,522,157.

Prof. Edwin Cannan, of London, lecturing in Johannesburg on March 28, congratulated South Africa on having decided in 1925 to go back to the gold standard, whether Great Britain did so or not, for this had the effect of driving Great Britain to do the same. "Had it not been for the lead given by South Africa," he declared, "I am sure Great Britain would still be quarreling over the paper pound."

The annual meeting of the Transvaal Chamber of Mines was held in Johannesburg on March 28. Arthur French, the retiring president of the General Mining & Finance Corporation, gave an exhaustive review of the position and prospects of the gold mining industry. The refinery at Germiston received 11,440,179 bullion ounces during 1926, an increase of 552,185 over the 1925 record. This increase is accounted for by the larger production on the Rand and also by increased receipts of bullion from Rhodesia and elsewhere. The greater part of the fine gold produced—8,646,734 oz.—was sold to the South African Reserve Bank. Gold sold to India direct totaled 873,757 oz. The Indian market also absorbed 924,000 oz. of silver, which was the total extracted from the 1926 gold bullion. Douglas Christopherson was elected president for the ensuing year, John Martin was elected vice-president, and Sir William Dalrymple second vice-president.

The share market on the Johannesburg stock exchange during the last week has been somewhat irregular, yet there have been notable improvements in certain gold and other shares. In Consolidated Main Reefs there has been heavy selling from London, yet the price here has risen from 23s. 4½d. to 24s. during the week.

Situation at the Mines

Moderate Curtailment in Copper and Zinc Production— Active Operations Prevail in Many Districts

By H. D. Keiser
Assistant Editor

UNDER THE INFLUENCE of the gradual decline in non-ferrous metal prices during the last month, definite indications finally appeared that a moderate curtailment in production was under way in several districts, at least in so far as zinc and copper were concerned. Apparently producers entertain the hope that the bottom of the market has been reached.

Copper—In the face of a low market, operations in the Michigan copper district remain active, and in some cases increases are noted.

Production in Arizona continues much at the same pace as in March. Inspiration Consolidated, Magma Copper, and the Ray mine of the Nevada Consolidated are operating on a curtailed production schedule, at least 20 per cent under normal, though practically all the other companies are on normal production. The leaching plant at Inspiration is working out satisfactorily. In Ray, the Nevada Consolidated is reported to have purchased the holdings of the Ray Hercules Mines, Inc. At Bisbee the Calumet & Arizona is extending its underground leaching to the pyritic areas of the Briggs orebody. During March the company produced 5,408,000 lb. of copper, an increase of 1,406,000 lb. over the record for March of the preceding year. Its subsidiary, the New Cornelia, at Ajo, furnished an additional 6,895,000 lb., the combined production amounting to 12,303,000 lb. Butte operations continue active, with extensive development work in progress; the labor situation is good.

Information that has recently come to notice regarding the high copper-low nickel ore diamond-drilled at the International Nickel Co.'s Frood mine in the Sudbury district makes it of major importance. Though production is over two years away, largely increased profits are indicated from the high copper content of the orebody, which can be mined without building up nickel stocks. The situation at Rouyn remains unchanged. Noranda is now sinking below 300 ft. and the next six months may be one of the most important periods in the company's history.

Lead and Zinc—In the Joplin-Miami district rumors are current that many mines are about to close down, owing to the low market. However, the latest available statistics, those dated April 30, show that during the preceding two weeks there was a net change of only five mills shut down.

Maximum lead production was maintained by the mines of the Coeur d'Alene district in April, in spite of the persistent decline in the price of the metal. Up to date there is no indication of curtailment of output. The effect of low zinc prices has been more in evidence. The Star mine of the Sullivan Mining Co. ceased production about April 1 and terminated its contract with the Vielle Montagne Zinc Co., of Belgium. This company will not resume production until the last of the year, when its electrolytic zinc plant, now under construction, is expected to be completed. The Highland-Surprise mine closed down the last of the month, not being able to dispose of its zinc product; shipments had been going to Belgium. The average price of lead during April called for a cut of 25c. per day in wages on May 1 under the sliding scale, but all operators agreed to waive the reduction and maintain the bonus of $1.25 per day, which means $5 per day for miners and $4.50 for muckers. This action has had a most beneficial effect. The Bunker Hill lead smelter operated two furnaces during the month, as usual. With the exception of unsatisfactory metal prices, conditions in the Coeur d'Alene district are good, and it is believed that normal production will be maintained with the exception noted in the case of zinc. The labor situation is satisfactory.

Operations at the Sudbury lead-zinc properties are of increasing importance and should soon reach a point permitting a decision regarding a mill.

Lead-Silver — Among the lead-silver producers of the Coeur d'Alene district the Sunshine Mining Co. is said to be shipping unusually high-grade ore from its mine on Big Creek. The Callahan Zinc-Lead Co. is also reported to be shipping from its Galena mine a substantial monthly tonnage of lead concentrates with a high silver content. Reports from Kellogg state that one of the greatest lead-silver strikes in the Pine Creek district has been made in the Idaho group north of the Nabob mine.

The recent recessions in the price of lead caused a temporary curtailment at Utah mines during the latter part of April. Production improved during the first week of May. The curtailment in actual metal output of the district during the next few weeks will probably not exceed 15 per cent.

Announcement is made that the Phelps Dodge Corporation is putting a 250-ton mill into operation at Warren, Ariz., to treat ores similar to those treated at the Shattuck-Denn mill. The corporation's lead smelter, now nearing completion at Douglas, will prove a great aid to lead producers in the state.

Gold and Silver — One correspondent likens the recent gold rushes and strikes in his state to a virulent epidemic of measles. The simile is apt. Following the Weepah, Nev., rush several milder rushes occurred in the state, the chief of which was at Beatty. New strikes were made in the Ord Mountain foothills in Maricopa County of Arizona and in the Pinal Mountain field; much recent activity has been reported in the Kingman and Oatman districts. In the East, rumors of new gold finds in North Carolina were heard. Two gold strikes within a week is the record of Yuma County, Ariz. The first was in the Kofa district, and the second at the Tritt mine. Apparently the Nyala gold camp, in the Willow Creek district of Nye County, Nev., is now in the "boom" stage.

The Tonopah production rate remains unchanged. Mine conditions are better in the Tonopah Mining Co., West End Extension, and Tonopah Extension mines. April production is estimated at $150,000. The Weepah boom is quieter but more substantial, with actual development started in a small way on several properties. Yukon-Treadwell, at Tybo, 60 miles east from Tonopah, is developing important ore on the 700 level. In the Manhattan district development operations principally are in progress. Limited shipments, about 30 tons per day, have been made from the White Caps mines to the Mason Valley smelter. Goldfield Deep Mines has cut stringers showing values in gold and copper. This is the only important work now being conducted in the Goldfield district. In the Battle Mountain district the Betty O'Neal mine is making good profits and the mine is reported to be in fine condition. The 75-ton cyanide plant of the Gold Circle Consolidated, at Gold Circle, is nearing completion. Additional high-grade gold-silver ore was recently developed in this property. The Virginia City district is quiet, with improved conditions in the Flowery mine; the Comstock Lode mining is practically discontinued.

Iron—The iron ore mines of the Lake Superior region are just getting into swing for the 1927 shipping season, but very little ore has been moved to date. With the early opening of navigation on the Lakes it was believed that there would be a rush of ore from the mines to the docks. Many of the underground mines are loading from pocket and stockpile, but few of the open-pit properties are very active. Sales of ore have been fairly good, and it is thought that about 55,000,000 tons will be moved. Many of the boats are in the grain trade and will not be available for ore until later. The Michigan state tax commission will announce its mine valuations about the middle of May; the tax question is all important to the mine operators. All of the bills which called for strict regulation regarding the operation of iron mines were defeated in the Michigan Legislature. Another large blast was made May 6 at the Volunteer mine of Pickands, Mather & Co., on the Marquette range. A total of 80,000 lb. of powder broke about 260,000 tons of siliceous iron ore. This was the largest shot ever made in the Lake Superior district.

American Business Goes to Geneva

Preparatory Work Thorough—Forty-seven Countries Represented at International Economic Conference Opened on May 4—First Four Days Devoted to Survey of World's Economic Ills

By Edward J. Mehren
Vice-President, McGraw-Hill Publishing Company, Inc.

Aboard S.S. "George Washington," April 27.—History in the making often has little appeal to us. Its significance has not yet become apparent. This thought has occurred to me again and again as I have watched and visited with the American delegates to the International Economic Conference.

The thought has been made more impressive by an autographed order of Benjamin Franklin's hanging in the library of the ship. Every schoolboy knows of the significance of Franklin's mission to the French court during the Revolution. Yet we have been little impressed at the time by the missions that have gone abroad in recent years to aid in one way or another in the stupendous task of restoring health to sorely exhausted Europe. Sometimes the fine fruits—as in the case of the Dawes Commission—were apparent before the close of the mission's task, so that the return of the members was met with loud acclaim.

On this ship is another mission whose going may in the future be looked on as Franklin's and other historial missions now are. To contribute of American experience to the solution of the world's economic problems, and particularly of those of Europe—such is the task and privilege of the gifted economic delegation aboard this ship.

Competence of Delegation

Of the competence of official delegates their distinguished records are sufficient evidence. Without exception they are students of international affairs and three of them are veterans in international conference, accustomed to the atmosphere of such gatherings and prepared from the opening signal to work efficiently. Henry M. Robinson, chairman of the delegation, is best known to the general public as one of the three American members of the Dawes Commission, the other two being General Dawes and Owen D. Young. But Mr. Robinson has a record in international conference even before his service on that distinguished body. From January to June, 1919, he was one of the five American members of the Supreme Economic Council, handling all manner of economic problems inherited from the war and advising with the President on peace treaty matters. Moreover, he and Samuel Gompers were the American members of the commission which drew up those sections of the peace treaty which set up the International Labor Office. By profession a banker (president of the First National Bank of Los Angeles) he has interests in many industrial enterprises, and therefore brings a broad comprehension of business problems.

Norman H. Davis has been almost continuously in the public eye in international affairs since the war. With a record of long business success, chiefly in enterprises in Cuba, he entered war work in connection with foreign loans in 1917. This took him to Europe, where he remained until after the armistice, serving as a member of the Armistice Commission, as a member of the Supreme Economic Council, as financial adviser to the President in the negotiation of peace, and subsequently as a member of the reparations and Financial Commissions. Later he was assistant secretary of the treasury and under-secretary of state, going to Europe afterward as chairman of the League of Nations committee to determine the status of the territory of Memel.

Dr. Alonzo E. Taylor, of Leland Stanford, agricultural expert, was examiner of prison camps in Germany, attached to the American Embassy during 1916, and then in 1917 was in charge of the blockade provisions on foods, feeds, and chemicals. Following the armistice, he surveyed conditions, with an eye to the needed relief, in Austria, Hungary, Poland, and the Balkans, remaining in relief work until 1921.

Dr. Julius Klein's experience in building up our foreign trade service is well known and has given him an unusually thorough knowledge of foreign conditions. John W. O'Leary's position as president of the U. S. Chamber of Commerce is proof sufficient of the opinion held of him by the business men of this country, and evidence of his competence to help in a conference of this sort.

Traveling with the delegation, bound for Geneva, not as a representative of the U. S. Government but of the International Chamber of Commerce, is Roland W. Boyden, of Boston. His qualifications for the assignment are indicated by his three years' service on the Reparations Commission (from April, 1920, to August, 1923). During this period, also, he was a delegate to the Brussels Financial Conference, representing the U. S. Treasury Department. Last year he was in Europe as a delegate of the International Chamber of Commerce on the Preparatory Committee which outlined and arranged for the forthcoming Geneva meeting.

The experts attached to the delegation are all qualified by long experience and all of them, too, are familiar with foreign conditions by study abroad. It would be invidious and unfair to single out one or two of them for mention, and space does not permit of the mention of the experience of all; but reference may be permitted to the labor expert, the veteran leader, John P. Frey, close associate of Samuel Gompers, and valiant champion of labor interests but of soundness and moderation as well. His contact with international labor matters began as far back as 1909, as a delegate from the A. F. of L. to the British Trade Union Congress. Twice during the war he was sent abroad on labor matters.

Such is the experience of the delegation that America is sending to Geneva.

Study of Problems

The seriousness with which the group is taking its committed task is evidenced by the thoroughness of its preparatory work. A dozen committees labored in Washington for several months compiling data. On the boat there have been two meetings a day, through good weather and bad, for discussion of the data and clarification of views. Even now, on the last day out, the sessions are still going on. As a result of these meetings one can sense the feeling that matters are well in hand and that the delegation and its experts will enter the sessions with confidence of their readiness to make a satisfactory American contribution to the conference.

The data prepared, one gathers, fall into three classes:

1. America's economic conditions and industrial experience.
2. Our knowledge of and data on conditions and experience of foreign lands.
3. Barriers and hindrances to foreign trade and to healthy industrial functioning.

Attitude of Delegation.—The meetings on shipboard have been private and no statements have been made regarding decisions on policy. But the attitude of the delegates, as revealed in general conversation, is clear. America is going there with no program. It is Europe's show. If any plan is presented, the American delegation will consider it carefully, and accept it if our laws, policies, and conditions permit. If plans that are proposed have been tried here, our delegates will tell whether they have worked with success or not. The delegates, of course, cannot bind our country or government.

To put it in another way, the attitude of our delegation seems to be to help as the Europeans want our experience and help, but not to tell the Europeans what to do. The attitude seems to be that the whole world can be made more prosperous without detracting from the prosperity of anyone—on the same principle that obtained in the earlier days of the automobile, for example, when the competition for business resulted not in stealing trade one from another but in developing more trade for all. There is a sincere desire to see Europe restored to full industrial vigor.

At the same time, these stalwart Americans can be counted on to defend the rights and position of our country and its business interests stoutly and adequately.

America's interests are in good hands.

The Opening Sessions

Special cabled report

Geneva, May 6—The International Economic Conference at Geneva opened on May 4, with forty-seven countries including Soviet Russia represented by delegates. The first four days were devoted to a survey of the world's eco-

nomic ills. There was general agreement that increased production was the indicated remedy, thereby increasing purchasing and consuming power and raising the standard of living. A striking note was the general solicitude for the well-being of workers, which was probably a new idea with European employers. The keenest analysis of the situation was made by W. T. Layton, editor of the *Economist*. He contended that we could not return to pre-war conditions. In his opinion a new equilibrium must be established, due, first, to the great increase of industrialization; second, to the fact that the United States is now a creditor nation, but apparently does not desire to buy from the countries she finances, contrary to the policies of former financing nations; third, to the decrease of European emigration; and, fourth, to the alteration of trade relations resulting from the payment of reparations and international war debts. The situation is more acute because Russian imports are small and Central Europe is divided by high tariff walls, resulting in duplication of industrial plants and preventing specialization which is the essential feature of modern industrialism.

Mr. Layton's insistence that the tariff walls of Central Europe must be lowered was approved by numerous speakers. There also was general approval of tariff stabilization regardless of the level, thus encouraging long-time contracts and uniform tariff classification and nomenclature. Long-time commercial treaties were advocated. There was no reference to American tariff rates, but several indirect references to our prohibition of immigration. Financing of backward countries was urged to stimulate production.

Dr. Carl F. Von Siemens, of Germany, criticized government intervention in industry, which was particularly interesting as coming from the representative of a country where government assistance and compulsion are considered normal. Zimmerman, of Holland, cited increased government services and restrictive labor legislation as increasing the industrial burden by raising prices, restricting consumption, and reducing trade. The remedies suggested were removal of government interference and reduction in the number of non-productive public servants. Only Shidachi, of Japan, and Layton, of Great Britain, cited the wastefulness of armaments.

The speech of Henry M. Robinson, chairman of the American delegation, was well received. He sketched the development of our prosperous industrial situation, stressing the determination of American employers to secure needed economies by better management and machinery, but not by wage reduction. He affirmed the American belief that competition stimulates industrial progress and suggested that the American delegation would probably disapprove of international cartels if governments participated or if they were exploitive in character. Answering Sir Max Muspratt, of England, who thought that rubber restriction bore equally on everyone, Mr. Robinson contended that there was discrimination against America, which uses 75 per cent of the output, as against only 7 per cent by Great Britain.

Sokolnikoff, of Russia, painted an optimistic picture, declaring that industrial and agricultural production are now in excess of pre-war outputs, but the figures are doubted here. He made a strong plea for closer capital and trade relations, contending that the capitalist and socialist systems can work harmoniously together. He protested the boycott of Russia.

Obolenski Ossinski, of Russia, criticised the capitalist system severely, declaring it to be the cause of the World War. He accused it of glaring inconsistencies, such as longer working hours while unemployment continued on a large scale. He condemned cartels and repeated Sokolnikoff's plea for trade relations, emphasizing the importance of the Russian market. In conclusion he offered eleven suggestions for restoring world trade and prosperity:

1. Cancellation of war debts.
2. Increase industrial wages.
3. Eight-hour day for all workers except miners, who should have six.
4. Fullest liberty for trade-union organization and complete liberty for strikes.
5. Relief for the unemployed.
6. Raise funds for the unemployed by taxation.
7. Decrease unproductive expenditure, especially for armaments.
8. Abolish barriers against immigration.
9. Cancel protectorates and mandates and permit self-determination for all peoples.
10. No intervention in China.
11. Suspend economic boycott on Russia and extend credits to that country.

It is not expected that the conference will have great or important immediate results but that it will contribute to a better understanding of international problems and will lay a basis for some definite actions now and in the future. Three speakers advocated permanent organization for the study of international economic problems. The plenary sessions closed on Saturday, May 7, and committee sessions on commerce, industry, and agriculture began on Monday, May 9.

Geological Society of South Africa Meeting

The annual general meeting of the Geological Society of South Africa was recently held in Johannesburg. Dr. R. B. Young, the president, announced that the Corstorphine medal for Geological Investigation had been awarded to Miss Edna P. Janisch for her thesis on "The Occurrence of Phosphates in Pegmatic Bodies in the Zoutpansberg district, of Northern Transvaal." Membership in the society has increased from 143 to 149 during the year. The president's valedictory address dealt with the growth of geology as a science in South Africa since the formation of the society in 1895. Dr. A. L. du Toit, leader of the Kalihari expedition, is to be president for the ensuing year.

Research Fellowships Offered by Mining Schools

Excellent opportunities for training in methods of scientific research in mining and metallurgy are afforded by a series of fellowships offered by a number of leading educational institutions for work in co-operation with the U. S. Bureau of Mines for the educational year 1927-28. Students receiving this specialized training are in demand in the industrial world.

The Mackay School of Mines of the University of Nevada, Reno, offers one fellowship. The holder will be assigned to research service with the staff of the Rare and Precious Metals Experiment Station of the Bureau of Mines.

Several fellowships are offered by the Department of Mining and Metallurgical Research, University of Utah, Salt Lake City. This department cooperates with the Intermountain Experiment Station of the Bureau of Mines. During the year 1927-28 the problems to be investigated are:

Flotation: Fundamentals on flotation of pure minerals and gangue constituents.

Hydrometallurgy of zinc: Study of losses in present hydrometallurgical practice and of their prevention where not due to mechanical causes.

Hydrometallurgy of lead: Purification of lead leach liquors. Pyrometallurgy of complex lead-zinc ores. Differential sulphating of complex ores.

Pyrometallurgy of lead: A study of the forms in which lead is lost in lead blast-furnace slags, and of methods for prevention of these losses.

Four fellowships are offered by the School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

The purpose of this work is to undertake the solution of definite problems concerning the mining and metallurgical industries of the State of Missouri. In co-operation with the Mississippi Valley Experiment Station of the Bureau of Mines, the four fellows will study problems affecting the metallurgy of zinc and the beneficiation and treatment of metallic and non-metallic ores.

The School of Mines of the College of Engineering of the University of Alabama offers five fellowships in mining and metallurgical research for work in co-operation with the Southern Experiment Station of the Bureau of Mines at Tuscaloosa, Ala. For investigation during the year 1927-28, fellows will study the beneficiation of low-grade bauxite ores, the beneficiation of phosphate rock, and float-and-sink treatment of Alabama coals.

The Arizona Bureau of Mines, a subdivision of the College of Mines and Engineering of the University of Arizona, Tucson, offers two fellowships in metallurgical and chemical research for work in co-operation with the Southwest Experiment Station of the Bureau of Mines. For study during 1927-28, the subjects will be:

Physical properties of copper mattes at various temperatures.

Capillarity in heap leaching of copper ores.

Diffusion as a factor in copper leaching.

Oxidation and reduction of iron solutions in heap leaching.

People You Should Know About

Aubrey Tennant, of the N'Changa mine, at Ndola, in Northern Rhodesia, and Mrs. Tennant, are in Pretoria on a two months' visit and will return north on May 15.

Fred Wartenweiler, assistant consulting metallurgist in the Corner House, Johannesburg, has left that city on a five months' visit to England and the United States.

Dr. Percy A. Wagner returned to Pretoria recently from Capetown, after making a visit to the new diamond fields at the mouth of the Orange River. He is now in Johannesburg.

F. C. Baker, of the New York office of the Consolidated Goldfields of South Africa, has sailed for London, where he will remain for two months before returning to the United States.

Joseph Clendenin, manager of the sales department of Guggenheim Brothers, sailed from New York last week for the Continent. Mr. Clendenin is expected to return about the middle of June.

Walter Douglas, president of Phelps Dodge Corporation, returned to New York on May 9 after an extensive trip abroad, during the course of which considerable time was spent in the mining districts of Africa.

H. I. Smith, associate chief, Conservation Branch of the U. S. Geological Survey, has returned to Washington, D. C., from an inspection trip made to the Western mineral-leasing stations of the Conservation Branch.

Joseph H. Lewis, formerly of the Braden Copper Co., recently returned from an extensive trip through the west coast of South America in the interest of the B. F. Goodrich Rubber Tire Co., of Akron, Ohio.

B. B. Thayer, vice-president of the Anaconda Copper Mining Co., recently made an inspection of the company's Montana operations. Mr. Thayer was accompanied by **E. Sengier**, managing director of the Union Minière mine, of the Katanga, Africa.

F. S. Turneaure recently resigned from the department of geology at Michigan College of Mines and accepted employment as geologist with the Patiño Mines & Enterprises Consolidated, Ltd., at the company's Oruro, Bolivia, tin properties.

Percy E. Hopkins, former geologist for the Victoria Syndicate, Coniston, Ont., has opened an office for consulting and exploration at 218 Dominion Bank Bldg., King and Yonge Sts., Toronto, Canada. Mr. Hopkins spent last month examining properties in the Sudbury area and is now in Porcupine district for a week.

Prof. L. T. Jones, of the University of California, will address a meeting of the American Welding Society, on May 17, at the Engineering Societies Building, 29 West 39th St., New York City. With **Prof. W. S. Weeks**, Professor Jones has conducted an extensive practical and scientific study of pipe-line field construction and welding by both gas and electric methods. Members of affiliated societies, including the A.I.M.E., have been invited to attend.

William Wraith, vice-president of the Anaconda Copper Mining Co., visited Salt Lake City recently and inspected the Tooele plants of the International Smelting Co. and Tintic operations. From Salt Lake, Mr. Wraith went to Butte. With him went **J. O. Elton**, manager of the International Smelting Co., and **J. S. Finley**, superintendent of Tintic operations, to confer with Anaconda officials relative to the sinking of a shaft on the North Lily property, adjoining the Titanic Standard near Eureka.

William Wraith

G. A. Joslin, mining engineer, of Los Angeles, has changed his address from the Central Building to 704 South Spring St.

An Appreciation of Asa Burton Hall

The tragic death of Asa Burton Hall, familiarly known as "Bert" throughout the mining fields of California and Nevada, shocked a host of friends and removed one of the most loyal supporters of the mining industry of the Southwest. Slipping in some unaccountable manner from the bucket at the collar of the shaft of the St. Elmo mine, one mile south of Atolia, in the Randsburg district, he fell the full length of the 240-ft. shaft. The tragedy came at 10 o'clock on April 10, at the height of the Randsburg celebration of the thirty-second anniversary of the discovery of the Yellow Aster mine. No man of his calling could be more acutely missed. A firm believer in the Randsburg district, an optimist through good times and bad, lending a willing hand to any project helpful to the industry, "Bert" Hall was the best publicity agent the district ever had. Nearly five years ago he returned to Randsburg after a long absence in Nevada, and a year or so ago organized the Nevada-Rand Gold Mining Co. to reopen the old St. Elmo mine, a former gold producer.

Born on Oct. 11, 1861, at Brookfield, Ohio, "Bert" was taken to Iowa by his mother, following the death of his father. About thirty-five years ago he joined the rush to the placer fields of Goler, Red Rock Canyon, and had followed the industry in all its branches ever since. He was married to Sara Frances Doud, formerly of Corry, Pa., in 1899, meeting her during his first association with the then new camp of Randsburg. Besides his widow, he is survived by his mother, Mrs. J. V. Skinner. As a friend of twenty years' standing, I knew him intimately. To him friendship meant everything worth while, and no material interest of his own was ever allowed to sway his professional judgment. Many a time he had opportunities of gaining wealth by methods that might not be open to the light of day, and to his credit be it said that he never took advantage of them. He believed in the mining industry, and he believed in the men who followed it. Throughout mining districts of the Southwest and on the streets of Los Angeles his familiar face and never-failing optimism will be missed. One more of the old-timers who loved the Mining West has passed on.

SIDNEY NORMAN.

Obituary

Sidney Lang, a mining engineer employed by the Eagle-Picher Lead Co., of Joplin, Mo., died recently in Chicago. Mr. Lang's home was in Houghton, Mich. He leaves a wife and three children.

Henry Joseph Krause, one of the best known of Kimberley diamond buyers, died on March 28. He went to Kimberley more than fifty years ago and was considered one of the best judges of precious stones. At one time he controlled the Kamfersdam Mine.

Dave Kennedy, mining prospector and gambler, is dead. At the time of his death he was on his way to the new gold camp at Weepah. Among the episodes connected with Kennedy's life, it is recalled that he led the drive for funds with which to rebuild the Butte Opera House when fire destroyed that building a score of years ago. Kennedy tackled the campaign with such enthusiasm that half the fund was raised and lumber for the new theater was on the scene before the embers of the razed structure ceased glowing.

Isaac Lewis, of the firm of Lewis and Marks, died at his home near Capetown, South Africa on March 29, aged seventy-nine. He was born at Neustadt, Kovno, Russia, in 1849 and went to South Africa in 1870, entering into partnership with his cousin, Samuel Marks. These two were among the early diggers and claim holders at Kimberley; but they sold out and bought the farm Maccauvlei, on the Free State side, near Vereeniging. About 1871, Mr. Lewis married Sarah Ann Tickton. Mrs. Lewis died in 1921. Besides being senior partner in the firm of Lewis & Marks, Isaac Lewis was a director of the Johannesburg Investment Co., the Swaziland Corporation, the South African Breweries, the V.F.P., the Imperial Cold Storage, and the Union Steel Corporation.

Recent Technical Publications

Reviews, Abstracts, and References

The Much Needed Handbook of Ore Dressing

Handbook of Ore Dressing. By Arthur F. Taggart. John Wiley & Sons, New York. Price $10.

In this handbook a great service has been rendered by the author and the seven contributors to those interested in the art of ore dressing. The volume meets a long-felt need. Ore dressing has advanced so rapidly in recent years that the few other and earlier texts dealing with the subject have been inadequate as reference books. This fact, together with the excellent manner in which the mass of information by Taggart is presented, assures it a hearty welcome among the members of the mining profession.

The book contains twenty-eight sections, seven of which are written by the contributors: Frederick E. Beach, Henry A. Behre, John M. Callow, R. C. Canby, W. Raymond Longley, Charles T. Porter, and Percev F. Smith.

After a brief introduction, the author takes up the discussion of the principal metals and non-metallic minerals whose ores require dressing as a part of their preparation, with data on occurrence, uses, production, price range, and selling. This is followed by a description of individual milling operations, such as coarse and intermediate crushing, fine grinding, screening, classification, methods of concentration, dewatering, and related operations. Then follow sections on sampling, handling of ores and treatment of products, design of milling plants, and metallurgy.

The mechanical equipment used in ore dressing is described in detail. Numerical data on performance under a variety of conditions are given. Crushing and grinding have been treated at length, with the latest practice set forth. The section dealing with flotation is especially noteworthy, the subject being treated extensively both as to theory and practice. Historical and legal points of view are presented, together with patent-number references for the various processes and reagents. A separate section is devoted to the design of milling plants from the initial testing of the ore to the final summary of cost. Data on mill performance are to a large extent new.

The plan adopted by the author in making textual references to literature is another feature of the volume. Reference matter is run in the text, set off in parentheses and abbreviated in the form adopted in legal writing. The distinct advantage of the method over number reference to a bibliography is that it makes immediately apparent to the reader acquainted with the literature the general source of the authority cited, and eliminates the irritation involved in search for the page of bibliography. The tables have been printed on tinted sheets of heavier stock than the other parts of the book, and they are therefore quickly located and should withstand considerable wear. The volume contains many excellent sketches, flow sheets and tables. It is printed in a clear and attractive type, and is well bound.

H. D. KEISER.

Railway Fuel. By Eugene McAuliffe. Simmons-Boardman Publishing Co., 30 Church St., New York. Price $5.

After serving in various capacities requiring him to handle fuel in a physical sense and then becoming a fuel agent for a big railroad system, Eugene McAuliffe shifted to a coal-mine managership and later to the presidency of a big coal subsidiary of a western railroad. Out of the fullness of his experience he has written a book on "Railway Fuel." Perhaps his immediate association with the coal industry has made him digress overmuch from the railway features of the problem into the history of coal disputes and of coal mining, into coal economics and machinery, for which offenses, however, the mining man and the coal man particularly will readily grant him absolution.

The metal miner will be interested to find him advocating for coal mines the multiple-shift method of operation so customary in metal mines. The author cannot understand why mines should work only about one-sixth of the year, idle every other day and when employed operating only a single shift in a possible three. Mr. McAuliffe advocates providing the miner with a warm meal in each shift, which is more desirable in the relatively chilly coal mine than in the warmer metal mine.

To the metal mine manager this book will be welcome, for he can use much of it—its coal classification and analysis, coal storage and perhaps also its mine methods and machinery. Also, the oil man may find some use for the chapters on fuel oil. However, the material that is most valuable to the metal and oil men can be found, and perhaps better found, in other books devoted to those special subjects. This is to be expected, as Mr. McAuliffe is addressing himself to an altogether different audience—the railroad man.

R. DAWSON HALL.

Our World Trade in 1926. — Value and Volume of Principal Exports and Imports Between United States and Chief Foreign Markets. By Foreign Commerce Department, Chamber of Commerce of the United States, Washington, D. C. Free distribution.

The year 1926 gave some further indication of the change in the foreign trade of the country which the economists have foreshadowed as the result of the comparatively new creditor position of the United States with regard to the rest of the world. Increasing imports and slightly decreasing exports brought the dollar value of the merchandise imports very close to the dollar value of the exports; for a considerable portion of the year the imports actually exceeded the exports. The big five among our export customers — the United Kingdom, Canada, Germany, France, and Japan—took well over half the total of our nearly five billions of dollars of exports; this despite the fact that three of the big five are in Europe, where practically all the chief countries spent less money on American goods last year than the year before. Canadian buying was very heavy, and South America, the Far East, Africa, and Oceania increased their purchases.

Mineral Resources — The following separates of "Mineral Resources of the United States, 1925," have recently been issued by the U. S. Geological Survey, and may be obtained from the Superintendent of Documents, Washington, D. C., at the prices quoted: "Tin," pp. 14, by J. W. Furness, 5c.; "Lead," pp. 16, by J. A. Stader and A. Stoll, 5c.; "Secondary Metals," pp. 21, by J. P. Dunlop, 5c.; "Gold, Silver, and Copper in South Dakota and Wyoming," pp. 5, by Charles W. Henderson, 5c.; "Gold, Silver, Copper, Lead, and Zinc in New Mexico and Texas," pp. 15, by Charles W. Henderson, 5c.; "Silver, Copper, Lead, and Zinc in the Central States," pp. 35, by J. P. Dunlop and H. M. Meyer, 10c.; "Lime," pp. 12, by A. T. Coons, 5c.; "Gypsum," pp. 6, by Jefferson Middleton, 5c.; "Mica," pp. 13, by W. M. Myers and Blanche H. Stoddard, 5c.; "Potash," pp. 9, by A. T. Coons, 5c.; and "Stone," pp. 32, by A. T. Coons, 5c.

Idaho Geology — "Geology and Ore Deposits of Boundary County, Idaho," are discussed by Virgil R. D. Kirkham and Ernest W. Ellis in Idaho Bureau of Mines and Geology Bulletin No. 10, pp. 78, obtainable for 50c. from the bureau at Moscow, Idaho. No orebodies of commercial importance have been found in this territory, but the area appears to be one worth further investigation, in which the information contained in this bulletin will be helpful.

Measuring Particle Size—The Jan. 28 issue of the *Journal* of the Society of Chemical Industry (Central House, 46 and 47 Finsbury Square, London, E. C. 2; price 1s. 9d.) contains a 5-page article by P. Lukirsky and M. Kosman on "A Method of Measuring the Size of Particles," based on the fact that if a powder consisting of particles of the same density, but of different sizes, forms a uniform suspension in some liquid, then the particles of different sizes will fall under gravity with different velocities.

Nevada Mining — The biennial report of the State Inspector of Mines, Carson City, Nev., for 1925-26, pp. 80, is now available. Statistical records of mine production are given, but most of the report concerns accidents, safety work being the chief duty of the Mine Inspector in Nevada. Copies will be sent on request.

Geological Survey Report—The annual report of the U. S. Geological Survey, Washington, D. C., pp. 96, discussing briefly the activities of its various branches during the year ended

June 30, 1926, and giving a descriptive list of its publications in that period, is available on request.

Bibliography of Geology—The U. S. Geological Survey recently published Bulletin 784, a "Bibliography of North American Geology for 1923-1924," by John M. Nickles, pp. 280. Paleontology, petrology, and mineralogy are included, reference being made to all textbooks and papers of general character by American authors, or that have appeared in American publications. Many foreign references are also included. Copies of the bulletin are obtainable for 40c. each from the Superintendent of Documents, Washington, D. C.

Economic Geology — The January-February issue of *Economic Geology* (Lancaster, Pa.; price 75c.) contains the following papers: "Tin Ores of Chocaya, Bolivia," pp. 13, by M. J. Buerger and J. L. Maury; "Separation of Fossils, etc., by Heavy Liquids, in Oil Geology," pp. 4, by M. H. Hanna; "Hydrothermal Alteration of Certain Silicate Minerals," pp. 26, by R. J. Leonard; "Intergrowths of Chalcopyrite and Cubanite," pp. 18, by G. M. Schwartz; and "Coals of Shensi and East Kansu, China," pp. 18, by M. L. Fuller and F. G. Clapp.

The March-April issue of the same magazine contains papers on "Zonal Distribution of Ore Deposits in Central Europe," pp. 20, by Georg Berg; "Origin of California Petroleum," pp. 25, by J. R. Takahashi; "Types of Mineralization and of Coast Range Intrusives," pp. 25, by A. F. Buddington; and "Changes in the Oxidation of Iron in Magnetite," pp. 9, by L. H. Twenhofel.

An index of the twenty volumes of *Economic Geology* from 1905 to 1925, inclusive, has recently been published, and is for sale at $3 by W. S. Bayley, University of Illinois, Urbana, Ill.

Patents

Patent Office Fees—The U. S. Patent Office announces new rates effective in connection with all patent applications filed on or after April 14, 1927, and all final fees paid on or after that date. Except in design cases, the fee on filing each original application for a patent shall be $20, plus $1 for each claim in excess of twenty. In every case which contains more than twenty claims, the payment after April 13, 1927, of a final fee of $20, or less than $20 plus $1 for each claim in excess of twenty, will not save the case from forfeiture.

Flotation—No. 1,620,761. March 15, 1927. H. H. Hendrickson, Aravaipa, Ariz., assignor to Grand Central Mining Co., Phoenix, Ariz. A method of preparing ores for flotation, which comprises treating the comminuted ore with a sulphidizing agent and water heated above 130 deg. F.

No. 1,624,559. April 12, 1927. T. M. Owen, Wallace, Idaho, and M. P. Dalton, Mullan, Idaho. Design for a flotation machine with mechanical agitators mounted on a horizontal shaft.

Hydrometallurgy — No. 1,620,873. March 15, 1927. N. C. Christensen, Salt Lake City, Utah. Ores containing galena are mixed with cold acid brine, the mixture is thoroughly agitated to liberate hydrogen sulphide, and the lead dissolved out.

No. 1,621,969. March 22, 1927. N. C. Christensen, Salt Lake City, Utah. In treating ores with chloride brines, the corrosive constituents of the solution are neutralized after treatment by adding a readily soluble oxidized compound to the mixture of ore and brine.

Rock-Drilling Equipment

No. 1,620,885. March 15, 1927. E. G. Gartin, Claremont, N. H., assignor to Sullivan Machinery Co. A controlling valve mechanism for a rock-drilling motor, and drill steel cleansing means.

No. 1,621,250. March 15, 1927. C. C. Hansen, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. Valve design for a rock drill.

No. 1,621,254. March 15, 1927. G. W. Hulshizer, Stewartsville, N. J., assignor to Ingersoll-Rand Co., Jersey City, N. J. Valve for rock drills.

No. 1,623,419. April 5, 1927. Gordon Lee, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. Design for a rock drill.

No. 1,624,312. A. E. Carlson, Los Angeles. Design for a rock drill bit.

Grinding Mill—No. 1,620,982. March 15,1927. R. C. Newhouse, Chicago, assignor to Allis-Chalmers Manufacturing Co., Milwaukee. Design for a two-compartment grinding mill, the primary grinding section of which is of larger diameter and of shorter length than the section devoted to finishing the grinding.

Vanadium Recovery—No. 1,621,038. March 15, 1927. K. B. Thews, Sawpit, Colo., assignor to Colorado Vanadium Corporation, New York City. In a process of recovering vanadium, the patent covers the addition of an oxidizing agent to a solution of soluble vanadates contaminated with iron and aluminum compounds, and adding a calcium reagent while keeping the solution non-alkaline to precipitate calcium vanadate.

Weight Indicator — No. 1,621,474. March 15, 1927. A. L. Blomfield, Kingman, Ariz. A means of separating solid materials according to their weight, using an indicating arm with electrical contacts.

Pulp Indicator—No. 1,621,535. March 22, 1927. H. E. T. Haultain, Toronto, Ont. An apparatus using an inverted U-tube for the purpose of determining the mean specific gravity of a stratum of pulp between two points at different distances from the bottom of a container.

Gold Washer—No. 1,621,697. March 22, 1927. J. L. Warner, Mayer, Ariz. A method of separating gold from clay-sand material, consisting of dry sizing, crushing, and stirring the undersize in water, washing the oversize, and finally precipitating the sand from the clay particles.

Treating Zinc-Gold Ore—No. 1,622,960. March 29, 1927. C. E. Meyer, Johannesburg, Transvaal. A means of treating zinc-gold slime, including an oxidizing vessel, a rabbler for receiving the product therefrom, and agitating means for effecting further treatment of the oxidized slime.

Vibrating Screen — No. 1,621,949. March 22, 1927. G. A. Overstrom, Pasadena, Calif. A vibrating screen supported on coiled springs and actuated by an unbalanced revolving member.

Dry Concentrator — No. 1,622,471. March 29, 1927. A. H. Stebbins, Los Angeles. Design for a dry concentrating table.

Timber Preservative—No. 1,622,751. March 29, 1927. K. H. Wolman, Berlin-Grunewald; Fritz Peters, Berlin; and Hans Pflug, Berlin-Steglitz, Germany. A preservative for wood, consisting of an oil of mineral origin and a complex salt of tartaric acid with arsenic and an organic base dissolved in it.

Mining System — No. 1,622,837. March 29, 1927. J. W. Pearce, Chicago, assignor to Goodman Manufacturing Co., Chicago. A plan for laying out entries in a mine.

Amalgamator—No. 1,623,421. April 5, 1927. F. D. Lewis, Denver. Design for a centrifugal concentrator and amalgamator.

Converting Nickel Matte—No. 1,623,797. April 5, 1927. Otto Lellep, Egypt, Pa., assignor to the International Nickel Co., New York City. In the converting of nickel-copper matte, the patent covers the forcing of oxygen-containing gases through the molten matte and reducing the content of free oxygen in the blast during the later stage of blowing.

Disk Crusher—No. 1,624,032. April 12, 1927. C. B. Andrews, High Bridge, N. J., assignor to Taylor-Wharton Iron & Steel Co., High Bridge, N. J. Design of an inner disk for crushing machines of the disk action type, provided with radial panels providing alternate thick and thin metal sections whereby sufficient resiliency is established to relieve the strain on the anchoring means.

Hearth Furnace—No. 1,624,043 April 12, 1927. F. A. Fahrenwald, Chicago. Design of a multiple-hearth furnace with movable rabble arms.

Classification—No. 1,624,134. April 12, 1927. S. H. Dolbear, San Francisco, and B. L. Eastman, New York, assignors to Selective Treatment Co. Ltd., Montreal. A method of classifying crushed material, such as asbestos fiber, by the use of water jets and employing centrifugal force.

No. 1,624,163. April 12, 1927. S. H. Dolbear and Victor Zachert, San Francisco, assignors to Selective Treatment Co., Ltd., Montreal. A method of separating fibrous substances into divisions according to length, which includes aërating an aqueous mixture thereof to recover the short fibers separately from the long fibers.

Ore-Bin Gates—No. 1,624,177. April 12, 1927. W. S. Orr, Massillon, Ohio, assignor to Central Alloy Steel Corporation, Massillon, Ohio. A method of operating ore-bin gates in connection with a car adapted to receiving the discharged material, the bin gates being operable from the car.

Air-Blast Classifier—No. 1,624,518. April 12, 1927. A. H. Stebbins, Los Angeles. An apparatus for the classification of dry material by the use of an air blast.

Market and Financial News

Lower Metal Prices Reduced Anaconda's Net Income for 1926 by $3,700,000

A DECLINE of about $3,700,000 in the income of the Anaconda Copper Mining Co. from operations and investments during 1926 compared with 1925 is shown in the current annual report. About $1,000,000 of this is accounted for by the shrinkage in the inventory value of metals on hand and in process, which are calculated at cost and are included in the consolidated income account. These inventories represent chiefly refined metals purchased by the American Brass Co. and metals in ores purchased from various mining companies for reduction. The quantity is approximately constant, but the higher prices obtaining during the closing months of 1925 as compared with the same period of 1926 account for the shrinkage in the total inventory value. John D. Ryan, the chairman of the board of directors, explains that to avoid this distortion in the future an arbitrary low fixed value will be placed on the metals and an inventory reserve account established. It is evident, of course, that the lower prices realized on metals produced has been an important factor in the decline in profits. The accompanying table shows comparative figures from the consolidated account of the company and subsidiaries for recent years.

Comparative Financial Statements of the Anaconda Copper Mining Co.

	1926	1925	1924
Gross income	$272,845,362	$263,415,956	$213,113,500
Operating expenses and taxes	250,345,372	236,861,718	197,060,811
Operating profit	$22,490,990	$26,554,238	$16,052,689
Other income	6,880,926	6,522,991	5,692,276
Total income	$29,371,916	$33,077,229	$21,744,965
Depreciation	$4,885,598	$5,049,348	$4,231,422
Interest	10,255,100	10,482,519	10,806,001
Net income	$14,226,202	$17,540,532	$6,719,215
Dividends	9,000,000	9,000,000	2,250,000

Operations of the company and its subsidiary and affiliated companies were conducted without interruption during the year and on about the same scale as during 1925. Output of manufactured products of the American Brass Co. and mills and the production of zinc was larger than in 1925, but the production of copper showed a decrease as compared with the record of the previous year. After the investigation of the properties of Giesche Spolka Akcyjna and Bergwerksgesellschaft Georg von Giesche's Erben, the company and its associates decided to exercise the option which they had to participate in the refinancing of these companies. Giesche Spolka Akcyjna owns extensive zinc ore and coal deposits in Polish Silesia.

In December, 1926, Anaconda purchased the outstanding one-half of the issued stock of the Anselmo Mining Corporation and is now the owner of all of the issued stock of that corporation. The Anselmo Mining Corporation owns a group of mining claims in the Butte district.

Construction expenditures during the year were mainly on items of construction that had been authorized during previous years. Expenditures, exclusive of those made by the Andes Copper Mining Co., totaled $7,726,302 and are summarized in the table below.

Anaconda's Construction Expenditures During 1926

Butte Mines, mainly on installations of electric hoists at the Badger State, Mountain Con., and Belmont mines	$1,482,316
Timber framing plant, rocker	289,351
Miscellaneous construction at Reduction works, Anaconda	94,060
Reduction works, Great Falls, mainly on extensions to copper refineries and zinc plant	1,442,366
Rod and wire mill, Great Falls, extension	280,048
The American Brass Co., improvements to buildings and machinery	1,412,379
Raritan Copper Works, mainly on power plant improvements	1,703,881
International Smelting Co., mainly on mill improvements and Cottrell treater at Tooele plant and mill at Rico, Colo.	586,536
Miscellaneous construction items	435,361

Montana Operations

The mines of the company at Butte produced during the year 2,562,344.55 tons of copper ore and 8,105.92 tons of precipitates were produced from the water pumped from the mines.

The Anaconda Reduction Works treated for all companies 2,882,903 tons of copper ore and other cuprous material. Of the total amount, 2,570,161 tons of ore was produced by the mines of the company; 269,920 tons of ore was purchased from other companies; 38,033 tons of material was shipped from the old plants at Anaconda and Great Falls; and 4,779 tons from the Great Falls zinc plant.

There were produced 254,317,367 lb. of fine copper, 8,227,177 oz. of silver, and 31,764 oz. of gold. Of this amount 254,302,568 lb. of fine copper, 8,226,723 oz. of silver, and 31,764 oz. of gold were produced for Anaconda.

There were cast from blister copper produced by the International, Utah, plant of the International Smelting Co., anodes containing 9,313,629 lb. of fine copper, 865,223 oz. of silver, and 7,449 oz. of gold.

During the year, 478,993 tons of zinc ore was concentrated. Of this amount 17,311.60 tons was from the mines of the company and 461,682 tons was purchased from other producers located in the Butte district. From this ore there were produced 97,765.43 tons of zinc concentrates and 5,683 tons of lead concentrates.

As a byproduct of copper smelting operations, 6,864,718 lb. of arsenic was produced, of which 6,668,068 lb. was refined. During the year 11,512,960 lb. was sold. The extension to the electrolytic and furnace refineries was completed during the year, and the capacity of this plant now is 312,000,000 lb. of cathodes per annum. Output of the copper refinery at Great Falls was 243,285,551 lb. of cathodes, of which 235,756,846 lb. was melted into shapes at that point. The new anode scrap melting furnace was completed in July, and during the remainder of the year returned 18,521,225 lb. of anodes to the copper refinery.

The two-unit extension, construction of which began in 1925, was completed and was put into operation during January, 1926. Zinc plants treated 19,192 tons of ore produced by the mines of the company and 626,493 tons of purchased ore and concentrates, a total of 645,686 tons.

The electrolytic zinc plant produced 225,857,493 lb. of zinc, 9,817,092 lb. of zinc in dross, 233,736 lb. of cadmium, and residue from which there were recovered 22,691,226 lb. of lead, 2,151,963 lb. of copper, 3,209,867 oz. of silver, and 7,080 oz. of gold.

The rod mill at Great Falls rolled into rods 168,306,036 lb. of copper; 41,527,844 lb. of rods was drawn into wire, of which 17,296,050 lb. was made into strand; 52,631,475 lb. of rods was shipped from this mill to Kenosha.

Output of manufactured products of the various plants for the year 1926 totaled 686,643,052 lb., an increase of 33,374,079 lb. over the output for 1925. The manufactured products were distributed among the various plants as follows: Ansonia, 177,565,033; Buffalo, 81,192,024; Hastings, 100,418,861; Kenosha, 145,058,456; Torrington, 64,215,924; Waterbury, 101,018,676 and Toronto, 17,174,078, the total being 686,643,052 lb.

Metal output of the Raritan Copper

Works was 393,201,524 lb. of fine copper, 21,735,903 oz. of silver, 132,335 oz. of gold, 20,905 lb. of selenium, 167 lb. of tellurium, 455 oz. of platinum, 1,223 oz. of palladium, 354,455 lb. of nickel sulphate, and 383,657 lb. of copper sulphate.

International Smelting Operations

All departments of the Tooele plant operated continuously during the year. The concentrator treated 343,126 tons of ore, from which there were produced 122,883 tons of concentrates, of which 38,416 tons was zinc concentrates, which were shipped to the electrolytic zinc plant at Great Falls. The copper plant treated 88,593.21 tons of ore and concentrates, from which there were produced 19,202,538 lb. of fine copper, 1,691,231 oz. of silver, and 16,100 oz. of gold. At the lead plant 285,294 tons of ore and concentrates was treated from which there were produced 135,658,034 lb. of lead, 7,032,273 oz. of silver, and 21,867 oz. of gold.

During the year the Miami plant treated a smaller tonnage than in 1925, resulting in a lesser production as compared with the previous year. There were treated 376,770 tons of concentrates and purchased ores, from which were produced 173,591,080 lb. of copper, 459,795 oz. silver, and 11,017 oz. gold.

During 1926 the Utah-Delaware mine produced 11,112 tons of copper ore and 134,169 tons of lead-zinc ores. In addition, 24,564 tons of lead-zinc ore was produced by leasers operating on a royalty basis. During 1926, the International Smelting Co. purchased a controlling interest in the Pelleyre Mining & Milling Co. and purchased the old Pro-Patria mill at Rico, Colo. The mill has been remodeled for selective flotation of lead-zinc ores, with a capacity of 250 tons daily. The new mill was started Nov. 1, 1926, and operated continuously for the remainder of the year, and during this period treated 10,675 tons of ore, from which there were produced 2,339 tons of zinc concentrates, averaging 48.90 per cent zinc, and 1,566 tons of lead concentrates averaging 59.30 per cent lead.

The refinery at East Chicago, Ind., treated 83,182 tons of lead bullion, from which there were produced 154,898,754 lb. of common lead, 8,112,230 lb. of antimonial lead, 8,319,378 oz. of silver, and 24,267 oz. of gold. There were produced from the plant at East Chicago, Ind., 12,726,707 lb. barreled white lead, and 12,085,870 lb. was sold.

Operations at the Walker mine, in California, were conducted throughout the year; 223,840 tons of ore was broken. The concentrator made an average recovery of 92.685 per cent; also, 250,082 tons of ore, averaging 1.872 per cent copper, was treated, from which 17,889 tons of concentrates, averaging 24.339 per cent copper, was produced.

Andes Copper Operations

At the Andes property, in South America, construction of the metallurgical plant for the treatment of sulphide ore and the preparation of the mine for production was resumed in February, 1925, and thereafter vigorously prosecuted, and at the end of 1926 was practically completed. The first ore was delivered to the coarse-crushing plant bins on Dec. 16, 1926, and the first copper was produced on Jan. 14, 1927.

The following data detail the amount of work performed in the two-year period on major items of construction and mine preparation:

Underground openings driven, miles	22.69
Structural steel erected, tons	13,596
Excavation work performed, cu.yd.	683,791
Concrete poured, cu.yd.	49,580
36-in. diameter steel pipe manufactured and laid, miles	32
Power-transmission lines erected, miles	88
Buildings in townsite construction	373
Maximum number of men employed	9,109

Imports and Exports of Ores and Metals in March, 1926 and 1927

Compiled from U. S. Department of Commerce Records

In pounds unless otherwise stated

Imports

	March 1926	March 1927
Antimony		
Ore, Gross weight	564,457	1,712,733
Ore, Antimony content	294,122	965,379
Liquated regulus or metal	2,957,965	2,270,496
Copper		
Ores	7,913,569	2,119,516
Concentrates	7,098,444	15,209,154
Regulus, coarse metal, and cement copper	41,445	79,660
Imported from:		
Spain	535,607	1,098,874
Canada	4,128,061	5,523,215
Mexico	2,797,657	2,781,050
Cuba	6,456,186	2,160,000
Chile	382,277	5,446,610
Peru	81,670	60,675
Other countries	672,000	337,906
Unrefined black, blister and converter copper in pigs, bars and other forms	26,599,162	40,121,645
Refined copper	13,307,537	17,927,908
Old and clippings for remanufacture	1,201,439	355,816
Composition metal, copper chief value	111,148	.....
Brass		
Old and clippings for remanufacture	987,634	865,102
Lead		
Ore and matte	11,313,492	6,009,026
Bullion or base bullion	4,429,129	21,489,978
Pigs, bars, and scrap	878,893	1,387,069
Babbitt, solder, and other forms, lead content	16,665	109,992
Type metal and antimonial lead, Gross weight	2,622,786	11,293
Type metal and antimonial lead, Lead content	2,031,474	8,921
Manganese		
Ore, tons, Cuba, gross weight	237	388
Ore, tons, Other countries, manganese content	27,391	22,717
Pyrites, tons	14,923	27,832
Tin		
Ores, tons	65	12
Bars, blocks, and pigs	15,151,804	13,319,272
Imported from		
Netherlands	505,346	1,782,953
United Kingdom	3,086,266	2,463,327
British Malaya	11,289,543	8,323,581
Dutch East Indies	116,838	.....
Hong Kong	22,463	117,011
Australia	22,400	134,400
Other countries	108,948	497,000
Zinc		
Ore, zinc content, Free	.....	.....
Ore, zinc content, Dutiable	3,109,429	1,772,220
Blocks, pigs, and old	8,148	1,524

Exports

	March 1926	March 1927
Copper		
Ores, concentrates, composition, and unrefined	43,980	622,204
Refined in ingots, bars, and other forms	72,185,100	80,029,368
Exported to		
Belgium	7,144,311	6,177,247
France	22,814,042	7,949,647
Germany	6,905,749	24,799,037
Italy	9,721,840	7,591,176
Netherlands	2,463,874	7,798,680
Spain	537,596	752,963
Sweden	1,278,312	2,356,970
United Kingdom	14,001,990	13,579,957
Other Europe	528,364	1,424,320
Canada	2,172,106	1,584,213
British India	1,837,135	100,800
China, Hongkong, and Kuantung (a)	470,400	607,040
Japan	2,015,550	4,871,222
Other countries	293,831	436,096
Old and scrap	1,582,547	4,071,848
Pipes and tubes	150,224	227,538
Plates and sheets	215,946	911,087
Rods	3,566,045	4,645,210
Wire	788,898	726,035
Insulated copper wire and cable	1,312,052	1,647,829
Lead		
In pigs, bars, and other forms	7,399,370	13,524,412
From domestic ore	2,660,973	80,322
From foreign ore	4,738,379	13,444,090
Exported to		
Belgium	672,198	672,151
France	1,624,314	.....
Germany	1,456,378	4,088,772
Netherlands	.....	224,069
Sweden	560,257	392,159
United Kingdom	1,064,379	4,033,272
Other Europe	112,546	225,135
Brazil	112,005	224,017
Other South America	579,537	136,815
Japan	896,250	2,464,732
Other countries	321,506	1,063,290
Other lead manufactures	1,854,481	698,726
Zinc		
Ore and concentrates, tons	9,070	2,269
Dross	1,351,841	695,919
Cast in slabs, blocks or pigs	5,124,675	8,377,657
Exported to		
Belgium	336,009	168,042
France	1,209,642	1,120,026
Germany	1,624,657	62,040
Italy	448,077	112,089
Netherlands	209,407	.....
United Kingdom	1,108,909	3,574,412
Other Europe	111,982	112,258
Japan	.....	2,054,344
Other countries	75,992	1,174,446
Sheets, strips other forms	567,735	871,310
Dust	117,807	97,901
Other zinc manufactures	92,431	211,532

(a) Hongkong and Kwantung not included in this figure for 1925.

The Market Report

Copper, at 13c., Comes to Life—Zinc Active—Other Non-Ferrous Metal Prices Hold Well

New York, May 11, 1927—Copper has sold in excellent volume in the week ending today, with prices almost uniformly at a firm 13c. delivered basis. Little business is reported in tin and lead is only moderately active. Zinc was in good demand and exhibits a somewhat stronger tendency than lead, in spite of a further reduction in ore prices at Joplin. The platinum market continues demoralized, with further important reductions in price. Antimony continues dull and weak.

Copper Sales Improve

With large buying by the leading consuming interest, copper became suddenly active last Friday, and a good business has been done ever since, though today there is perhaps a little cessation in the inquiry. Most of the buying has been by consumers in the East, including an occasional order from a wire mill, and the price has been almost uniformly 13c. delivered. In the Middle West, an occasional order has been placed at 13¼c., but sellers have found a disinclination to pay that much, and it seems likely that copper—perhaps Michigan copper—has been offered to Middle Western consumers at close to 13c. There is some talk of advancing quotations to Eastern consumers to 13¼c., but apparently no one has yet taken that step. Most of the orders have been for June shipment, with a liberal quantity for July and an occasional request for May and August. All are quoted at the same price. Foreign business has picked up markedly, and the export association has been limiting the amount sold. The export price is still 13.35c., c.i.f.

Lead Quiet but Steady

Little change has taken place in prices for lead in either the foreign or domestic market during the week ending today. The American Smelting & Refining Co. has maintained its official contract price at 6.75c., New York, and 6.40c. has been the prevailing figure in the St. Louis market. Occasional lots were sold at prices from 2½ to 5 points below these, but the total tonnage at cut rates was not large. Despite the fact the Mexican ore lead is all going abroad, prices in London have been well maintained. Apparently consumption in both Great Britain and Germany, or at least the demand for consumption in the near future, is increasing. A significant feature in the domestic market is that practically all of the moderate volume of business is for May shipment. This indicates "hand-to-mouth" buying in an unusual degree and suggests that one of the periodic buying waves may start if and when consumers reach the conclusion that the bottom of the market has been reached. To date, little information indicating material curtailment in production is available, but curtailment may be under way at the mines.

Zinc at 6.10@6.15c.

The zinc market has been more active than for seven weeks, with practically all business at either 6⅛ or 6.15c., St. Louis, though some was sold as low as 6.10c. Zinc generally is in strong hands. Though stocks increased last month, it is felt that production will be curtailed to accord with the demand, especially now that ore in the Tri-State district has dropped below $40 a ton, and that further price reductions are unlikely. At present prices, it is possible to export zinc, and this has been done to a certain extent, as the foreign demand is rather good. Brass Special has sold for 5 points' premium, and High-Grade is offered in carload lots at 8c. delivered in the East.

Statistics of the American Zinc Institute, in tons of 2,000 lb., follow:

Stock, April 1	36,279
Produced	51,626
Shipped	46,697
Stock, April 30	41,208
Shipped from plant for export	1,876
Total retort capacity, April 30	136,644
Number idle retorts available within sixty days	57,297
Average number of retorts operating during April	81,582
Number retorts operating April 30	81,096

Daily Prices of Metals

May	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y	99 Per Cent	Straits	N. Y.	St. L	St. L
5	12.775	65.25	68.625	6.725@6.75	6.40	6.125@6.15
6	12.775	64.75	68.125	6.75	6.40	6.125@6.15
7	12.775	64.875	68.25	6.75	6.40	6.125@6.15
9	12.775	65.00	68.375	6.75	6.40	6.15
10	12.775	64.375	68.00	6.725@6.75	6.375@6.40	6.15
11	12.775	64.125	68.00	6.75	6.375@6.40	6.10
	12.775	64.729	68.229	6.746	6.396	6.135

Average prices for calendar week ending May 7, 1927, are: Copper, 12.767c.; 99 per cent tin, 64.688c.; Straits, 67.708c.; N. Y. lead, 6.744c.; St. L. lead, 6.404c.; zinc, 6.127c.; and silver, 56.063c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
5	54¾	55¼	61¼	299⅞	290½	25 13/16	26 5/16	29 7/16	29 11/16
6	55	55½	61¼	297¼	288	25⅝	26⅛	29½	29 11/16
9	55 5/16	55 13/16	61¼	299	289½	25 9/16	26 1/16	29 9/16	29¾
10	55 9/16	56⅛	61¼	297½	288⅛	25 7/16	26 1/16	29 9/16	29¾
11	55¼	55 13/16	61½	297¼	288	25⅜	26	29 5/16	29½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
5	4.85½	56¼	26	84s11d	9	4.85 7/16	56⅛	26 1/16	84s11d
6	4.85⅜	56	26 1/16	84s11d	10	4.85 7/16	56⅛	25 15/16	84s10¼d
7	4.85 7/16	56	25⅞	.....	11	4.85 7/16	56	25 15/16	84s11½d
					Avg.		56.083		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Straits Tin Scarce

Last Thursday it developed that very little Straits tin for prompt shipment was available in the domestic market. The price jumped more than a cent, though it was largely nominal. Subsequently some consumers postponed delivery on early contracts, thereby releasing sufficient near-by metal to supply the meager requirements. The spread between Straits and 99 per cent is particularly wide because of the fact that an ample supply of the lower-grade metal from England is afloat. Today, June Straits is 1¾c. under near-by delivery.

Fluctuations in Lire

Italian lire fluctuated over a considerable range during the week, but cable quotations closed on Tuesday, May 10, at 5.41c. Francs closed at 3.91¾c. and marks at 23.66c. Canadian dollars are at ⅜ per cent premium.

Silver at 56c.

During the last week silver prices fluctuated within narrow limits, India being a moderate buyer at about the present level. China remains inactive, and though the market closes steady, the future tendency is uncertain.

Mexican Dollars (Old Mexican pesos): May 5th, 42⅜c.; 6th and 7th, 42⅜c.; 9th and 10th, 42½c.; 11th, 42⅜c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 98 or 99 per cent grade, price of leading interest, 26c.; outside market, 25.30@25.80c. London, 98 per cent, £105@£107 per long ton for domestic consumption.

Antimony—Per lb., duty paid, New York: Chinese brands, spot business at 13¼@12¾c.; June arrival about same level; Cookson's "C" grade, spot, 18c. Market dull. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

Bismuth—Per lb., New York, in ton lots, $2.20@$2.25. London, 8s.

Cadmium—Per lb., New York, 60c. London, Australian metal selling freely at 1s. 10d.

Iridium—Per oz., $105@$110 for 98 @99 per cent sponge and powder.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton, according to quantity.

Palladium—Per oz., $54@$58. Small lots bring up to $60. Pure metal as a constituent of crude platinum, nominal.

Platinum — Official price quoted by the leading interest on small miscellaneous orders for refined metal, $86. Price cut from $95 on May 9. Open market cash sales of large lots, in New York, $78@$83. Pure metal as a constituent of crude platinum, nominal. Market remains dull with price weakening.

London, £18@£19 per oz. for refined and £17@£18 for crude. Dull.

Quicksilver — Per 75-lb. flask, $124@$125. Steady. Demand good. San Francisco, $125. London, £20½.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of May 7.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@40c. Business dull. Chemical grades unchanged from quotations in the May 7 issue.

Tungsten Ore — Per unit of WO_3, N. Y.; Wolframite, $10.50@$10.75; Western scheelite, $11@$11.25. Dull; prices largely nominal.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the May 7 issue.

Blende and Galena Prices Lowered Again This Week

Joplin, Mo., May 7, 1927

Blende

High	$40.16
Premium blende, basis 60 per cent zinc	$40.00@41.00
Prime western, basis 60 per cent zinc	39.00
Fines and slimes, 60 per cent zinc	38.00@36.00
Average settling price, all zinc	40.16

Galena

High	$92.40
Basis 80 per cent lead	85.00
Average settling price, all lead	90.01

Shipments for the week: Blende, 14,573; lead, 2,025 tons. Value, all ores, the week, $767,660.

An additional number of small producing mine mills and several tail mills have been closed because the product could not be marketed at a profit, and yet the price on both zinc and lead sought new low levels. The low price is weeding out properties that have operated on a thin margin of profit. Others will be forced to follow with the further cut in the price this week. At noon no ore had been sold this week, on the $39 basis being offered today, and if any sales are made it is probable that buyers will need remain long after usual office hours tonight. Including smelter-owned ore, which in transfer to the buyer is listed with the purchases, it seems evident in the late afternoon that the total purchase will not exceed 7,000 tons of zinc concentrate. As the cost price per ton of concentrate is estimated at $45 per ton, only those mines producing lead concentrate can afford to continue long in operation.

Platteville, Wis., May 7 ,1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$42.75
Lead Ore	
Lead, basis 80 per cent lead	$87.50

Shipments for the week: Blende, 1,286 tons; lead, none. Shipments for the year: Blende, 23,508; lead, 640 tons. Shipments for the week to separating plants, 2,584 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fullers Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from prices in the May 7 issue.

Mineral Products

Arsenious Oxide (White Arsenic)—3¾c. per lb. Quiet. London, Cornish white, per long ton, £16½.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate and **Zinc Oxide** are unchanged from prices in the May 7 issue.

Ferro-Alloys

Ferrochrome—Per lb. of contained chromium, 60@70 per cent chromium, 4@6 per cent carbon, 11½c.

Ferromanganese—Domestic and foreign, 78@82 per cent, $95 per long ton, furnace or duty paid, for delivery during first half of 1927. Spiegeleisen, 19@21 per cent, $37, f.o.b. furnace; 16@19 per cent, $34; nominal.

Ferrotungsten—$0.98@$1.03 per lb. of W contained, f.o.b. works. Market spotty.

Ferrocerium, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferro-uranium and **Ferrovanadium** are unchanged from prices in the May 7 issue.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 15@15¼c. f.o.b. mill.

Lead Sheets—Full rolled, 10½c. per lb.; clipped, 10¾c.

Nickel Silver—28¾c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19¼c. per lb.; rods, 16¼c.

Zinc Sheets—9¾c. per lb., f.o.b. mill.

Refractories

Chrome Brick, Fireclay Brick. Magnesite Brick, Silica Brick and **Zirkite** are unchanged from quotations in the May 7 issue.

Steel, Pig Iron, and Coke Markets Inactive

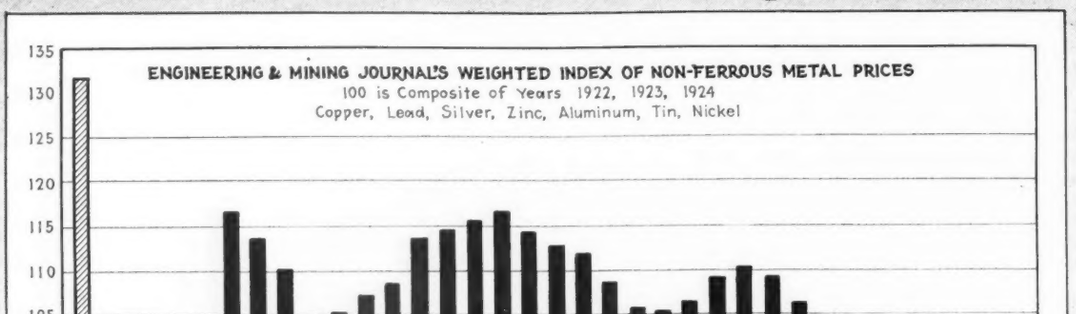
Pittsburgh, May 9, 1927

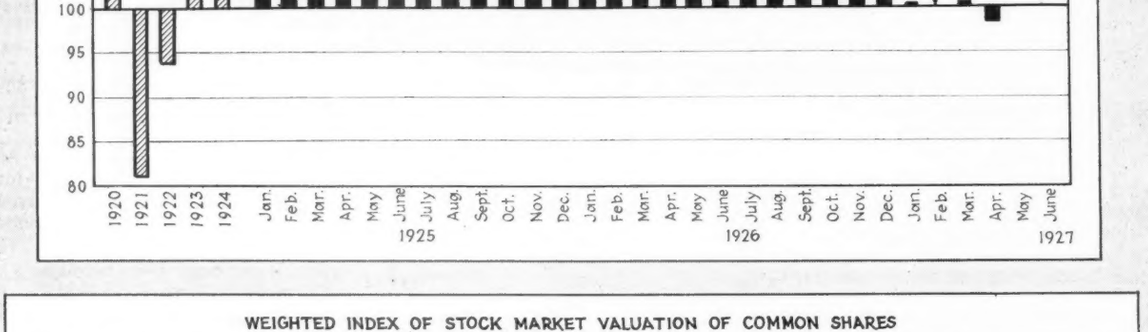
Steel market news of the week is colorless. There is not much appearance of activity, but mill operations seem to be experiencing no more than the slight decrease that has characterized this season in the last two years. Steel production is scarcely off more than 10 per cent from the March rate, which was record high.

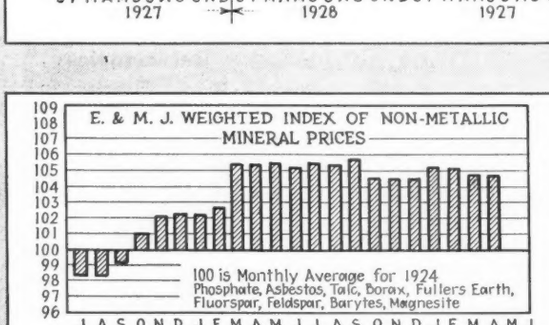
Pig Iron—The valley market remains quiet. Efforts to obtain above $18.50 on foundry iron have been entirely abandoned. Quotations: Bessemer, $19.50; basic, $18 50; foundry, $18.50, f.o.b. valley furnaces.

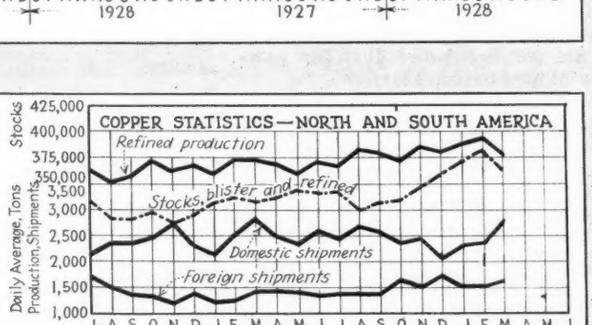
Connellsville Coke — The spot market has declined and is soft at the new levels of $3.00 for furnace and $4.00@$4.75 for foundry, there being scarcely any demand.

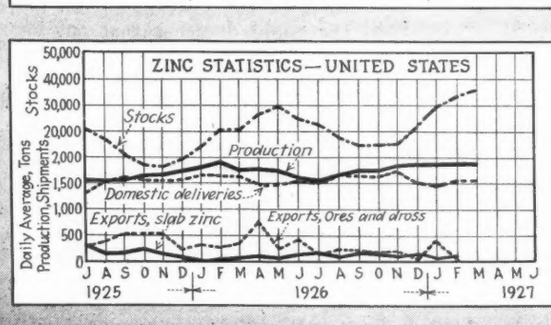
E.&M.J. Statistics of the Mining Industries

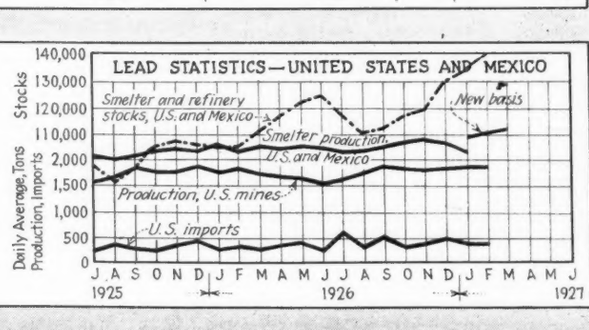

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922, 1923, 1924
Copper, Lead, Silver, Zinc, Aluminum, Tin, Nickel
100.01
1925
1926
1927




E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth, Fluorspar, Feldspar, Barytes, Magnesite
1925
1926
1927







Review of Current Statistics

By A. B. Parsons
Associate Editor

DEVELOPMENTS bear out the forecast made a month ago that April would show a decline in the *E. & M. J.* Weighted Index of Non-Ferrous Metal Prices, in spite of the reversal of the downward trend that took place in March, and the apparent habit of the curve to decline or ascend over considerable periods, rather than to reverse itself from month to month. The biggest factor in the decline was lead, followed in order by copper, zinc, and tin. Silver improved appreciably; aluminum and nickel did not change.

Lead reached 6.85c. in New York, and so far this month has suffered a further decline, the A. S. & R. price being 6.75c., with metal available at some concession from this figure. Not since the summer of 1923 has lead been so low. The current price contrasts sharply with that of January, 1925, when a peak of 10.575c. was reached. This figure was abnormal; but the average for the entire year of 1925 was 9.02c. and for 1926 the average was 8.41c. Zinc is in a position but little less enviable, being at the lowest level since 1924. As to copper, a measure of consolation may be had from the fact that April did not see a repetition of the sag to 12.30c. that shocked the industry in February, 1927. The accompanying table gives a picture of the position of the major metals.

It is imperative, of course, to recognize the decline in the general level of commodity prices that has persisted with but minor interruptions for about two years. However, the opinion prevails that conditions within the mining industry—principally high production rates—have depressed prices to a greater extent than can reasonably be attributed to the general price decline. Tending to support this view is the fact that domestic deliveries of copper were very high during April and that manufacturing activity in the "metal trades" as indicated by the kilowatt-hour consumption of power was at an extremely high rate in April.

Average Metal Price for Various Periods

Metal	1925	1926	Four Months, 1927	April, 1927
Copper, lb.	14.042	13.795	12.890	12.808
Lead, lb.	9.020	8.417	7.425	7.126
Silver, oz.	69.065	62.107	56.35	56.399
Zinc, lb.	7.622	7.337	6.591	6.338
Aluminum, lb.	27.5	26.99	26.06	26.00
Tin, lb.	57.893	65.285	68.172	67.933
Nickel, lb.	33.00	35.0	35.00	35.00

No movement is shown in the Index of Non-Metallic Mineral Prices. Barytes advanced slightly, but a decline in feldspar prevented any net change of consequence.

International Nickel, abetted slightly by American Smelting & Refining, is responsible for the sharp advance in the Index of the Stock Market Valuation of shares in the mining-smelting-manufacturing group. The situation in International Nickel is rather complicated. Large bodies of nickel-copper ore of higher grade than the reserves hitherto known have been developed; and, from reliable sources come reports of important discoveries of copper ore in adjoining territory. These of course are valuable assets; but they are not likely to be realized upon for some years. So far as nickel is concerned, the output is governed by the capacity of the market to absorb it, and though the demand is gradually increasing, no sudden expansion in production is likely. At current prices, somewhat under $60, the shares are paying considerably less than 4 per cent and the probability is that the strength of the market arises from the technical position. Reports are current that various pools are operating in the stock. Incidentally the shares were dragging at $11 three or four years ago.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920			130.92
1921			80.80
1922			93.94
1923			103.43
1924			102.63
1925			111.74
1926			107.74
	1925	1926	1927
October	115.64	106.20	
November	116.69	104.21	
December	114.15	102.31	
January	116.38	112.66	100.46
February	113.50	111.91	100.01
March	110.20	108.95	100.84
April	104.75	105.93	98.63
Average first four months	111.21	109.86	99.98

In common with the rail and industrial shares the seven companies in this group suffered a reaction during the last week of the month that brought them down from much higher levels to which they climbed during the early part of the month. Anaconda, for example, reached $47½, but closed at $45⅝. A. S. & R. declined to $145½ from $150½; New Jersey Zinc from $187 to $180¾; International Nickel from $60⅝ to $56; and National Lead from $196 to $192¾. Anaconda's annual report, showing a shrinkage of $3,700,000 in earnings for 1926, compared with 1925, though not issued publicly until after May 1, probably figured in the decline.

A net gain of about $2 each on Kennecott's 4,497,000 shares did most to turn the Index of Copper Share prices upward again, although the following closed April at higher levels than a month ago: Calumet & Hecla, Nevada Consolidated, New Cornelia, Granby, and Chile. Against these are declines of some moment in Inspiration, United Verde Extension and Old Dominion. Inspiration suffered most, this being the third successive month in which it has declined sharply. Kennecott reached $65¾ late in the month, but reacted slightly with the general list. For ten months the index number has gone this way and that in a narrow range, getting nowhere in particular. A few of the best have improved, and some of the weaker ones have fallen off, with little change as the net result on the index number.

Little of particular moment transpired in the miscellaneous group. Cerro de Pasco and St. Joseph Lead eased slightly and because of their relative size, financially speaking, offset several small increases, among them Lake Shore and Hollinger, gold producers in Northern Ontario. The silver-lead properties in Idaho and Utah showed a divided tendency: some went up, others down, but in neither direction were the changes important.

Three alterations have been made in the graphs showing current production. On page 828 the data on smelter production compiled by the American Bureau of Metal Statistics now include output of two important producers that consume their own smelter output. The figures for January, February, and March of 1927 show approximately 100 per cent of the primary production of the United States and Mexico. An approximation of the difference that this makes can be made by observing the break in the curve on the vertical line for January, 1927, where the daily rates under both the old and new methods of reckoning are shown. Turning to page 830, there will be observed breaks in the lines for world production of both lead and zinc.

It will be noted that the curve for copper production is crossed by that for lead. No one should deduce from this, however, that any change in the relative rates has taken place. In 1924 the production of copper exceeded that of lead; but in both 1925 and 1926, the advantage lay with the "gray" metal.

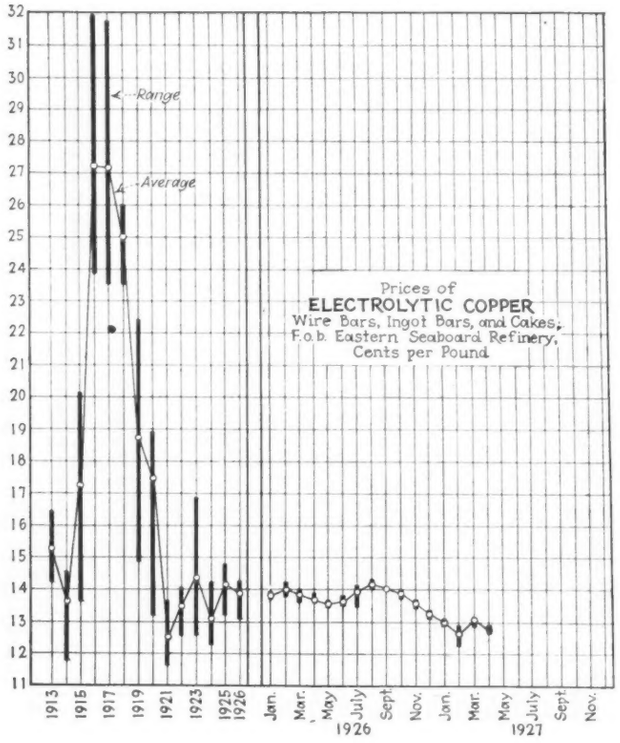
Closing Prices of Common Shares

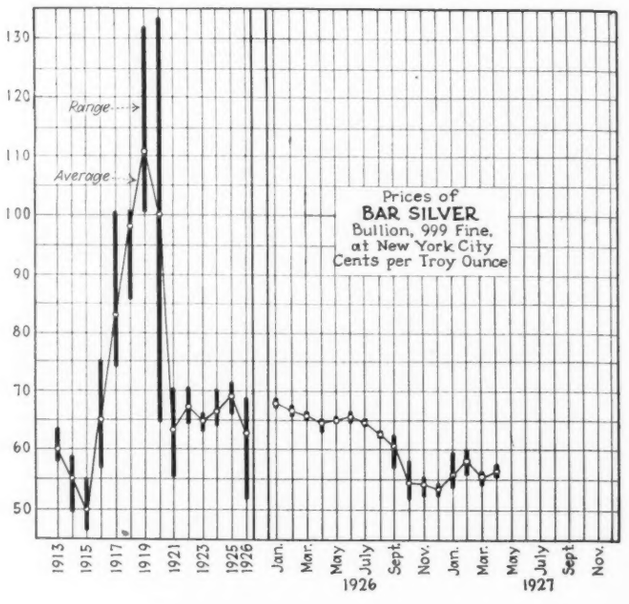
Company	1924	1925	1926	Apr 1927
Anaconda	47¼	49¼	49	45⅛
A. S. & R.	99¾	142½	147⅛	145½
New Jersey Zinc	195	207½	187½	180¾
International Nickel	26¼	45	37¼	56
National Lead	160	167¾	173½	192¾
U. S. Smelting	40¾	49¼	35¼	37½
American Metal	52¼	54½	42¼	41½

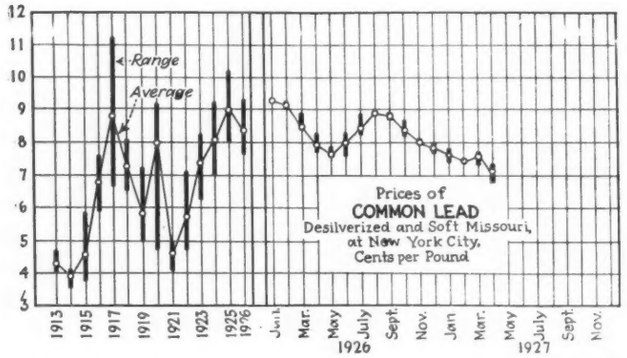
The copper statistics for March—now by no means fresh—all show a trend favorable to the producer: Lower production rates; increased shipments, both for domestic and foreign destinations; and a sharp decline in stocks. The prophets are unanimous in declaring that a continuation of this improvement will be revealed in the April figures soon to be issued. May they not be disappointed!

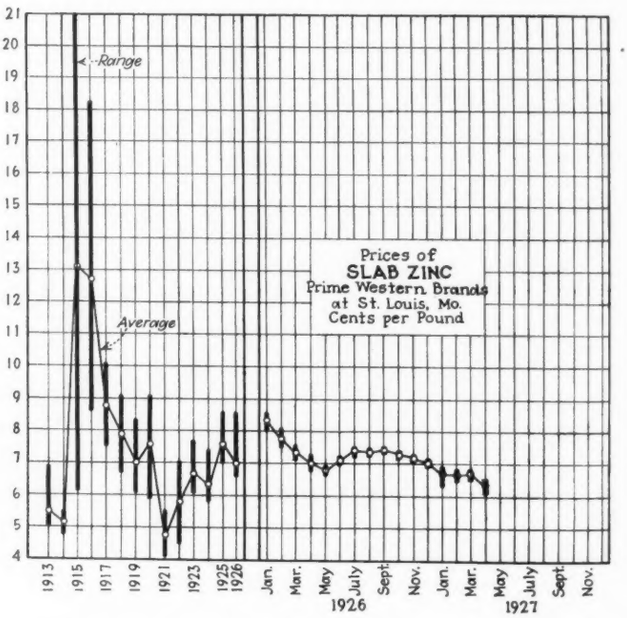
Nothing so encouraging appears in the statistics for lead and zinc, although it must be noted that the latest data are for March and even, in the case of lead, for February. It has been remarked that economic laws do not operate in a vacuum; economic forces are subject to the operation of conflicting and deflecting forces that are not recognized. However, the recent trend of the prices for lead and zinc certainly squares with the behavior that the economist would predict if he were to base his conclusions solely on a study of the tonnage data shown at the bottom of page 828.

Metal Price Curves

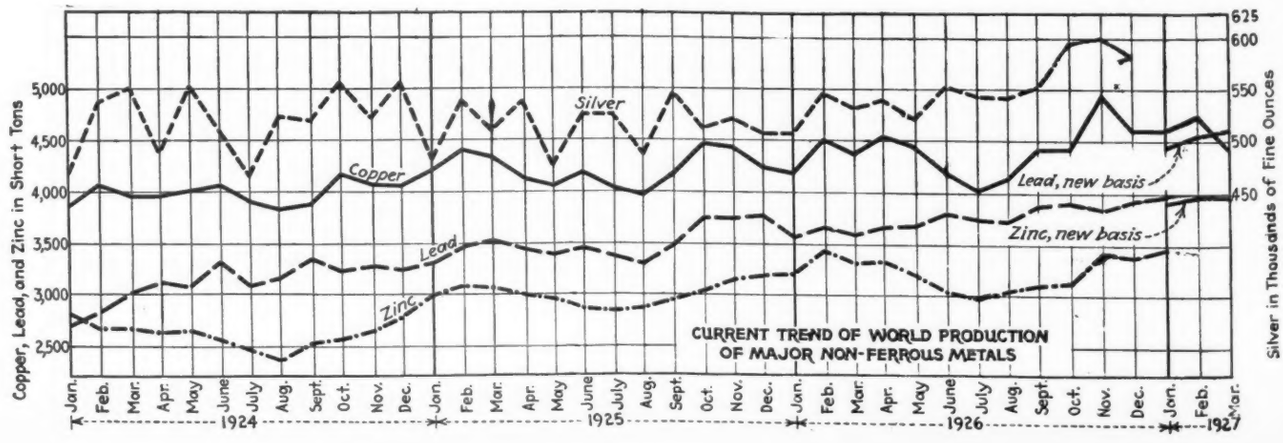








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce between 97 and 98 per cent of the world's copper and 81 per cent of the world's silver. Figures now being published by the bureau include a larger proportion of the silver than indicated, but an adjustment has been made so that the figures are comparable. Starting with January, 1927, the bases for lead and zinc have been changed so as to represent 90 per cent of the lead instead of 78, and 97 per cent of the zinc instead of 87.5. With the preparation of a new chart next month a longer "history" of zinc production on the new basis will be shown.



Mining Stocks—Week Ended May 7, 1927

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda	New York	45⅞	45⅜	45⅝	Ap.16,May21 Q 0.75
Arcadian Consol.	Boston	*28	*28	*28	
Ariz. Com'l.	Boston	7	6½	7	Ja. 7, Ja. 28 0.50
Calaveras	N. Y. Curb	2 1/16	2 1/16	2⅛	
Calumet & Arizona	New York	68⅜	67⅛	67⅜	Ma. 5, Ma. 21 Q 1.50
Calumet & Hecla	Boston	16⅜	15⅝	15⅝	My.31, Jn.15 Q 0.50
Cerro de Pasco	New York	62¼	60⅞	61½	Ap.14, My.2 Q 1.00
Chile Copper	New York	37	36⅛	36⅞	Jn.3, Jn.30, Q 0.62½
Con. Coppermines	N. Y. Curb	3⅛	3	3⅛	
Copper Range	Boston	13	12	12⅝	Ap.2, My 2, A 1.00
Crystal Copper	Boston Curb	*30	*25	*27	
East Butte	Boston	1 1/16	1⅛	1⅛	Dec., 1919 0.50
Granby Consol.	New York	38⅛	37⅛	37⅛	May, 1919 1.25
Greene-Cananea	New York	45½	42⅛	44⅜	Nov., 1920 0.50
Hancock	Boston	*32	*30	*30	
Howe Sound	New York	39½	38	39½	Apr.1,Apr.15 Q 1.00
Inspiration Consl.	New York	18⅞	18	18⅞	Ma.17, Ap.4,Q 0.25
Iron Cap	Boston Curb			1	
Isle Royale	Boston	10	9⅜	9⅜	Fe.4, Fe.19 Q 0.50
Kennecott	New York	65	63¾	64⅜	Mar. 4 Apr. 1 Q 1.25
Magma Copper	New York	34½	33½	34	Ma.31,Ap.15,Q 0.75
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	
Miami Copper	New York	15⅞	15⅜	15⅝	My.2,My.16 Q 0.37½
Mohawk	Boston	39	38⅛	39	Ap.30, Jn.1 Q 1.00
Mother Lode Coa.	New York	4⅛	4	4⅛	De.10, De.31SA 0.37½
Nevada Consol.	New York	14⅜	14⅛	14⅛	Ma.17,Ma.31Q 0.37½
New Cornelia	Boston	23	22	22	My.6, My.23Q 0.50
Noranda	N. Y. Curb	23	22	22⅞	
North Butte	Boston	2⅜	1 1/16	1⅛	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	*50	*49	*50	Sept., 1926 0.03
Old Dominion	Boston	12⅜	12	12⅛	Dec., 1918 1.00
Phelps Dodge	N. Y. Curb	115¼	115	115	Ma.22, Apr.2 Q 1.50
Quincy	Boston	16	15⅜	15⅜	Mar., 1926 1.00
Ray Consolidated	New York	15⅜	15⅛	15⅜	Ap.20, Ap 30 0.25
St. Mary's Min. Ld.	Boston	22⅛	21⅛	22⅛	Fe.10 Ma.10 2.00
Seneca Copper	New York	2⅛	2⅛	2⅛	
Shattuck-Denn	Boston Curb	4⅜	4⅛	4⅜	
Tenn. C. & C.	New York	12⅛	11⅛	11⅜	Fe.28, Ma.15, Q 0.25
United Verde Ex.	N. Y. Curb	24½	23⅜	24	Apr.6, May1 Q 0.75
Utah Copper	New York			115	Ma.17,Ma.31Q 1.50
Utah Metal & T.	Boston	1⅜	1⅛	1⅜	Dec., 1917 0.30
Walker Mining	Salt Lake	*55	*48½	*55	
NICKEL-COPPER					
Internat. Nickel	New York	59½	55⅝	59½	Ma.17,Ma.31Q 0.50
Internat. Nickel, pfd.	New York			105	Ap.14,My.2 Q 1.50
LEAD					
Gladstone Mtn.	Spokane	*23⅜	*23	*23½	April, 1927 0.005
National Lead	New York	195	191½	193	Jn.10,Jn.30 Q 1.25
National Lead pfd.	New York	130½	129½	130½	My.10,Jn.15Q 1.75
St. Joseph Lead	New York	39⅜	39	39⅛	Se.10,Se.20, QX 0.75
ZINC					
Am. Z. L. & S.	New York	7⅛	7⅛	7⅛	May, 1917 1.00
Am. Z. L. & S, pfd.	New York	46⅝	46	46⅝	Nov., 1920 1.50
Butte C. & Z.	New York	5⅛	4	5	De.9, De.24 0.50
Butte & Superior	New York	9⅛	9	9⅛	Ma.15, Ma.31Q 0.50
Callahan Zn-Ld	New York	1⅜	1⅜	1⅜	Dec., 1920 0.50
Consol. Lead&Zinc'A'	St. Louis	13⅛	13	13	Ma.15, Ap.1 Q 0.25
Eagle-Picher	Cincinnati	26⅛	26⅛	26⅞	Au.15, Se.1 Q 0.40
Eagle-Picher, pfd.	Cincinnati			116	Jn.30, Jy.15 Q 1.50
New Jersey Zn.	N. Y. Curb	181	179	180	Ap.20,My.10 Q 2.00
United Zinc	N. Y. Curb			55	
Yellow Pine	Los Angeles	*25	*25	*25	Dec. 1925 Q 0.04
GOLD					
Alaska Juneau	New York	1⅜	1⅛	1⅛	
Argonaut	Toronto	*59	*42½	*54	
Barry-Hollinger	Toronto	*42	*32	*36½	
Carson Hill	Boston	*50	*50	*50	
Consol. W. Dome L.	Toronto	*10	*7¾	*9½	
Cresson Consol. G.	N. Y. Curb	2 1/16	2	2	Ma.31,Ap.10Q 0.10
Dome Mines	New York	8½	8⅛	8⅜	Ap.18, My5,Q 0.25
Golden Cycle	Colo. Springs	†1.60	†1.55		Fe.28,Ma. 10 Q 0.04
Hollinger Consol.	Toronto	21.10	20.60	20.95	My.4, My.20 0.10
Homestake Mining	New York			61	My.20,My.25M 0.50
Kirkland Lake	Toronto	1.54	1.33	1.47	
Lake Shore	Toronto	19.50	19.00	19.40	Ma.1, Ma.15 0.10
McIntyre-Porcupine	New York	26	25	26	My.2, Jn.1 Q 0.25
Portland	Colo Springs	†*47	†*45		Ap.6, Ap.15, Q 0.02
Rand Mines	New York			9½	Au.23-30Am.Sh. 1.52
Teck-Hughes	Toronto	7.85	6.97	7.85	Ja.31, Fe. 1 0.05
Tom Reed	Los Angeles	*40	*40	*40	Dec., 1926 0.02
Tough-Oakes	Toronto	*52	*48	*49	
United Eastern	N. Y. Curb			*44	July, 1924 0.05
Vipond Cons.	Toronto	1.25	1.05	1.11	Apr.1 Apr.15 0.03
Wright-Hargreaves	Toronto	11.40	10.95	11.40	Ap.15,My.2 0.10
GOLD AND SILVER					
Carnegie Metals	Pittsburgh	12⅜	12⅛	12⅜	
Con. Cortez	N. Y. Curb	*22	*20	*21	
Con. Virginia	San Francisco	*4⅛	*3⅛	*4⅛	
Dolores Esperanza	N. Y. Curb			*45	July, 1923 0.05
Premier Gold	N. Y. Curb	2⅛	2 1/16	2⅛	Ma.15, Ap.4Q 0.08
Tonopah Belmont	N. Y. Curb	1⅝	1⅛	1⅝	Ma.15, Ap.4 0.08
Tonopah Extension	N. Y. Curb			*26	Apr. 1925 0.05
Tonopah Mining	N. Y. Curb	2⅜	2 1/16	2⅜	Ma.31, Apr.21 0.07½
West End Consol.	N. Y. Curb	*11	*9	*9	Mar., 1923 0.05
Yukon Gold	N. Y. Curb			*45	June, 1918 0.02
SILVER					
Beaver Consol.	Toronto	1.19	1.00	1.19	May. 1926 0.03
Canadian Lorrain	Toronto	*27	*26	*27	
Castle-Trethewey	Toronto	*93	*83	*83	
Coniagas	Toronto	3.95	3.75	3.75	May, 1924 0.12½
Keeley	Toronto	1.37	1.30	1.34	Fe.28, Ma.15X 0.12
Lorrain Trout Lake	Toronto	*27	*20	*20	July, 1925 0.05
McKinley-Dar.-Sav.	Toronto	*17	*16	*16	Oct., 1920 0.03

Stock	Exch.	High	Low	Last	Last Div.
SILVER—(Continued)					
Mining Corp. Can.	Toronto	3.50	3.40	3.50	De.30, Ja.15 0.12½
Nipissing	N. Y. Curb	6⅜	6¼	6¼	Ma.31, Ap.20 Q 0.15
SILVER-LEAD					
Ahumada	New York	4	3⅜	4	Ma.25,Ap.4,QX 0.12½
Bingham Mines	Boston	46¼	45	45	Ma.21, Ap.5 Q 1.00
Bunker Hill&Sullivan	N. Y. Curb	76	74½	74½	Ma.31,Ap.4MX 0.75
Cardiff M. & M.	Salt Lake	*58	*52	*53	Feb. 5, 1927 0.10
Chief Consol.	Salt Lake	2.65	2.47½	2.65	Oc.10, No.1 Q 0.10
Consti'n Mng.&Mill'g	Spokane	*28½	*24	*24	
Erupcion	Boston Curb	*55	*50	*51	Ma.25, Ap.2 Q 0.07½
Eureka Lily	Salt Lake	1.42½	1.35	1.37½	
Federal M. & S.	New York			112	
Federal M. & S., pfd.	New York	93¾	88	93¾	Fe.24, Ma.15 Q 1.75
Hawthorne Mines	N. Y. Curb	*4	*3	*4	
Hecla Mining	N. Y. Curb	13½	13½	13⅝	Fe.15,Ma.15 Q 0.25
Highland-Surprise	Spokane	*8	*7	*8	
Iron King Mining	Salt Lake	*50	*34	*47	
Keystone Mining	Salt Lake	*30	*30	*30	Au.12, Au.26 0.07½
Lucky Jim	Spokane	*21½	*20⅜	*21	
Lucky Tiger-Com.	Kansas City	†7.00	†6.50		Ap.20, 1927 M 0.05
Mammoth Mining	Salt Lake	2.00	1.85	2.00	De.17, De.23,Q 0.25
Marsh Mines	Spokane	1.75	1.25	1.75	
North Lily	Salt Lake	2.95	2.70	2.90	
Park Utah	New York	6⅜	6⅜	6⅜	Ma.15, Ap.1 Q 0.20
Plutus Mining	Salt Lake	1.80	1.80	1.80	Ja.10, Ja.15 Q 0.10
San Rafael	San Francisco			*24	
Silver King Coal.	Salt Lake	8.00	7.60	8.00	Ma.21, Ap.1 Q 0.25
Silversmith	Spokane	*33½	*32⅜	*33½	Oc.1, Oc.10 Q 0.02
Strattons Mines	Spokane	*43	*36	*43	
Sunshine M. Co.	Spokane	*63	*60	*62½	
Tamarack-Custer	Spokane	*29½	*28½	*29	Sept., 1924 0.25
Tintic Standard	Salt Lake	10.87½	10.75	10.87½	Ma.16, Ma.29X 0.40
Utah-Apex	Boston	5⅛	5⅛	5⅛	Oct., 1926 0.25
IRON					
Bethlehem Steel	New York	52⅜	48½	51½	July, 1924 1.25
Cleveland-Cliffs Iron	Cleveland	78	76	77	Ja.15, Ja.25 Q 1.00
Colorado Fuel & Iron	New York	91½	75⅛	89½	May, 1921 0.75
Gt. North'n Iron Ore	New York	20⅜	19½	20	Dec.6, Dec.28 0.75
Inland Steel	New York	43½	42½	42⅞	My. 13, Jn.1 Q 0.62½
Replogle Steel	New York	10	9½	9½	
Republic I. & S.	New York	66½	63⅞	66½	My.14 Jn. 1 Q 1.00
Republic I. & S. pfd.	New York	103½	103	103	Jn.14, Jy.1 Q 1.75
Sloss-Sheffield S. & I.	New York	127⅞	127	127⅞	Ma.10, Ma.21 Q 1.50
Sloss-Shef. S.&I. pfd.	New York	106	106	106	Ma.21, Ap.1 Q 1.75
U. S. Steel	New York	169⅜	164⅜	169⅜	Jn.7, Jn.29 Q 1.75
U. S. Steel pfd.	New York	121⅛	118⅛	121⅛	My.2,My.28, Q 1.75
Virginia I. C. & C.	New York	50⅛	49	49	Jan., 1924 1.50
Virginia I.C.&C.pfd.	New York			60½	De.15, Ja.2, 2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN					
De Beers Consol.	New York			30⅛	Ja.26, Ja.29 1.45
So. Am. Gold & P.	N. Y. Curb	20⅜	20⅛	20⅜	
Alum.Co.of Amer.	N.Y.Curb	68⅜	68⅛	68⅛	
Alum. Co. of Amer pf.	N.Y.Curb	104½	104½	104½	Ma.15,Ap.1 Q 1.50
Vanadium Corp.	New York	48⅛	46⅜	48	My.2. My.16Q 0.75
Patino M. & E.	New York	23½	21⅜	21⅜	Ap.27, My.5 1 sh.
ASBESTOS					
Asbestos Corp.	Montreal	21½	21	21⅛	Jan., 1926 1.50
Asbestos Corp., pfd.	Montreal	86⅜	85	86⅜	Ma.31,Ap.15 Q 1.75
SULPHUR					
Freeport Texas	New York	68⅜	63½	68⅜	Ap.15, My.2 Q 1.00
Texas Gulf	New York	64⅞	59⅜	64⅛	Ma.1, Ma.15Q 1.00
MINING, SMELTING, REFINING AND GENERAL					
Amer. Metal	New York	42	41⅜	42	My.20, Ju. 1 Q 0.75
Amer. Metal pfd.	New York	110½	110⅛	110⅛	My.21, Ju.1 Q 1.75
Amer. Sm. & Ref.	New York	151½	145½	150⅜	Ap.14, My.2 Q 2.00
Amer. Sm.&Ref.pfd.	New York	126⅜	125⅞	126⅛	My.6, Jn.1 Q 1.75
Consol. M. & S.	Montreal	256	250	255½	De.31, Ja.15 X 6.25
Federated Metals	N. Y. Curb	12	12	12	
Newmont Mining	N. Y. Curb	74½	73⅜	74½	Ma.31,Ap.15 Q 0.60
U. S. Sm. R. & M.	New York	37	36	36⅜	Ap.7 Ap.15 Q 0.87½
U. S. Sm. R.&M.pfd.	New York	48⅜	48	48	Ap.7, Ap.15, Q 0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED APRIL 26, 1927

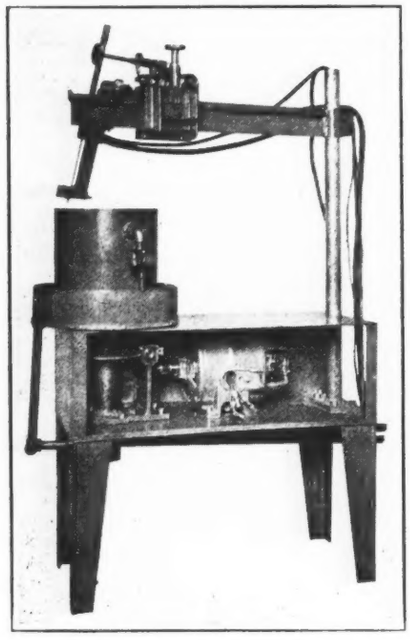
Name	High	Low	Last	Last Div. Date	Amount
Aramayo Mines (25 frs.)	85/7½	84/—	85/—	Feb. 1927	5 (†)
British Platinum (£1)	3/7½	3/3	3/6	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/1½	13/9	13/9	Feb. 1927	6 annas*
Bwana M'Kubwa (5s)	6/4½	6/1½	6/3		
Camp Bird (2s)	4/9	4/7½	4/9		
El Oro (£1)	4/4½	4/1½	4/4½	Nov. 1924	2½ p.c.*
Esperanza (10s)	—/2	—/2	—/2		
Frontino & Bolivia (£1)	12/6	12/—	12/—	Jan. 1927	5 p.c.
Mexican Corpn (£1)	10/9	9/—	10/3		
Mexico Mines of El Oro (£1)	16/3	15/1½	16/3	Dec. 1926	3½ p.c.*
N'Changa Copper Mining	11/6	10/7½	10/7½		
Oroville Dredging (£1)	6/9	6/4½	6/9	Dec. 1923	3½ p.c.
Ouro Preto (£1)	4/6	4/3	4/6	May 1925	2½ p.c.
Rhodesian Congo Border (£1)	58/3	52/6	55/—		
St. John del Rey (£1)	12/9	11/9	12/6	May 1927	3½ p.c.
San Francisco Mines (10s)	32/6	31/6	32/3	Jan. 1927	25s.
Santa Gertrudis (£1)	17/—	15/3	16/6	Jan. 1927	3½ p.c.
Selukwe (2s. 6d.)	10/3	9/3	9/6	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/3	3/—	3/3	Nov. 1917	75 p.c.
Tanganyika (£1)	71/6	50/9	56/3	Aug. 1926	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	10.200	90.85	91.60	July 1926	175 (‡)

* Free of British income tax. † Swiss frs ‡ Belgian frs. and free of taxation.

New Machinery and Inventions

Automatic Carbon Arc Welder Welds Under Water

The accompanying illustration shows a new carbon arc-welding machine built by the Lincoln Electric Co., Cleveland, Ohio. This machine, it is claimed,



Automatic carbon arc welder

has been found adaptable to welding of pieces in which no preparation of the edges to be welded is made. It will weld circular seams up to 12 in. in diameter. A feature is the cooling tubs around the revolving table which carries the piece being welded. The piece on which the welding is being done may be partly or totally immersed in water during the welding operation. Cooling water is in circulation in the tubs during operation. This novel cooling arrangement was developed to meet the requirements when welding high-grade alloy steels on which the heat disturbance due to application of welding heat must be reduced to a minimum. In the case of 12 per cent manganese steel the welding may be done with the piece totally immersed in water and the arc submerged. This arrangement is well adapted to the welding of manganese steel, as the rapid quenching of the molten metal gives it the physical properties expected in 12 per cent manganese steel.

The frame and details of the machine are all made of welded-steel construction and the machine itself is an example of the rapidly growing tendency to use welded steel construction in place of gray-iron castings.

Something New in Grease Cups

Such a standard accessory as a grease cup has been considerably improved by the Link-Belt Co., 910 South Michigan Ave., Chicago. This company has introduced a cup having a hexagonal top which offers easy purchase for any type of wrench as well as a good grip for the hand. This cup is known as "Hex-Top." In it is combined a compression grease cup and Alemite fitting.

An example of the cup's use is afforded in the lubricating system of a long belt conveyor using a number of grease cups for the idlers. The quickest and most economical way to fill all the cups at one time, it is said, is with a grease gun applied to the Alemite fitting, when the cap is turned up to a high point, but not entirely removed. The cup holds a good reserve of grease for use of the compression feature.

Machine Cuts Kerfing Time and Makes Task Easier

Sawing wood may be either good exercise or arduous labor, according to the mental attitude or physical condition of those who perform the operation. In mining work where in most cases posts, lagging, and the like must be cut to length and to fit underground it usually partakes of the nature of labor. In order to lessen the severity of this work both within the mines and elsewhere the Reed-Prentice Corporation, of Worcester, Mass., has recently placed on the market the Wolf sawing machine shown in the accompanying illustration.

As may be seen, the active element of this device somewhat resembles the cutter bar of a mining machine and the principle of operation is the same. Naturally, however, the speed of the chain is much higher, so high in fact that it is claimed by the makers that all pitchy and fibrous materials are thrown off by centrifugal force as the chain rounds the sprockets. This machine will therefore cut bark and resinous woods without difficulty. It operates on 220-volt, 60-cycle 3-phase current and can be readily carried from place to place by one or two men.

It is claimed by the makers that the machine will cut dimension stock either at right angles or at any skew up to 45 deg.; that it will cut such timber without dogging or fastening; that it cuts smoothly and accurately to line and inasmuch as it requires no stroke room it can be used in confined places where it would be impossible to swing an ordinary cross-cut saw. It is also claimed that the time of cutting is reduced to from one-third to one-fourth that necessary with ordinary saws.

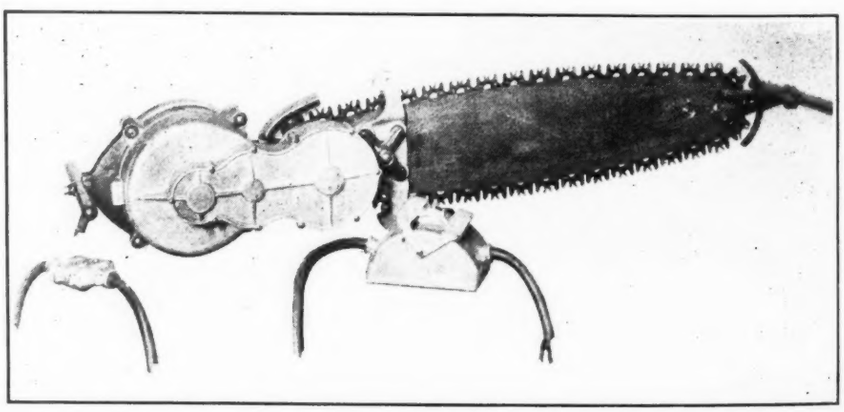
Maintaining Furnace Linings by New Method

If refractory construction could be maintained in a condition approximating its newly built state, it is readily apparent that lining life would be materially prolonged and that refractory repair costs would be greatly reduced. Botfield Refractories Co., Philadelphia, Pa., has developed a method of maintenance that, it claims, makes it easy to keep refractory construction in good condition through periodic and systematic maintenance.

By this new method, it is claimed, linings can be returned to good condition whenever the equipment is out of service for a short time. Sometimes the repairs can be made without interrupting the operation of the equipment. Cracks, crevices, joints, and brick pores can be filled up quickly and efficiently. Burned-out sections and depressions can be patched. Walls can be maintained at their original thickness, with a smooth uniform surface presented to the attack of flame and other destructive elements encountered in operation.

Three major elements are employed. They are the Adamant gun, Adachrome (a chemically neutral refractory material), and Adamant firebrick cement. The gun is used for blowing protective coatings on brickwork in the form of pre-mixtures of Adachrome (or other refractory materials) employing the cement as a binder.

Weighing less than 4 lb., the gun requires only one man for operation. It uses air or steam at 50 lb. pressure or more. As air is more satisfactory in results, its use is recommended wherever possible. The operator simply connects the air line to the ¼-in. standard pipe thread opening on the globe valve of the gun, places the supply pipe in the pre-mixture, turns the globe valve, and the gun sprays the pre-mixture, smoothly and evenly on the structure. Thus, all brick pores, open joints, cracks and crevices are quickly filled up, and the wall is given a protective coating that is highly refractory and resistant to the attack of fusible coal ash, sulphur and other impurities in either coal or oil fuel which cause fluxing, slagging, or melting of the brick.



An electrically driven sawing machine